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Electricity Shop's Sole Heat Source

Steel Foundry Utilizes Current for Annealing Castings and Baking Molds and Cores as Well as for Melting — Specializes in Light Castings of Intricate Design

BY H. E. DILLER

IN THIS country of great manufacturing achievements, the motive which prevails in every line of industry is to produce on a vast scale and to organize for large accomplishment. The railroads constantly are striving to increase the train load capacity for freight, and building heavier locomotives and cars with a larger carrying capacity. Steel mills endeavor to break each new record for tonnage rolled in a given time. Repetition methods bring higher production in foundries. While this tends to divert attention from accuracy and leads some to slight the fine points in manufacturing, industries such as the watchmaking and precision instrument enterprises, which demand extreme accuracy at all times, are successful in accomplishing fine adjustments. However, even these industries are carefully organized to manufacture on a large scale and are fitted with automatic machinery wherever possible. There is no temptation for them to drift into lines requiring less painstaking methods and giving more volume of production because there are no such openings in their branch of manufacture. However, the steel foundryman who starts with a purpose to solicit only that class of trade which demands castings that require minute care in their production constantly is confronted by the appeal to take work which can be turned out rapidly and with comparatively little care. Such work gives a larger output and makes a greater showing. Then, too, when the demand for the finer castings is slack, the temptation is strong to fill the shop with any work which may be had. The coarser work must be turned out at a lower price per pound and so cannot be given the detailed consideration which the molder is in the habit of devoting to the regular class of work in the shop. After a molder has worked for a while on the heavier castings, it is difficult for him to come back and give the care necessary to the finer castings.

These considerations have caused many companies which have started with the intention of specializing on delicate castings gradually to drift from their original intentions and fill its shop with quantity work. One of the latest companies to start with the avowed purpose of specializing on the production of small intricate castings is the Emery Steel Castings Co., Baltimore. From the following description of the equipment which this company has installed, it may be seen that its nature will have a tendency to hold the company to its original intentions in this plant. The characteristic of this equipment is that electrical heat is used in all cases. Beginning with the electrical melting furnace, the metal is cast in molds dried in an electrical oven and annealed in an electrical annealer. Heavier castings which could be made from a steel inferior to electric furnace steel, and not requiring annealing or dried-sand molds would render these electrical furnaces and ovens superfluous. Before deciding on the type of furnace to be adopted, I. C. Emery president and engineer of the company, made a study of

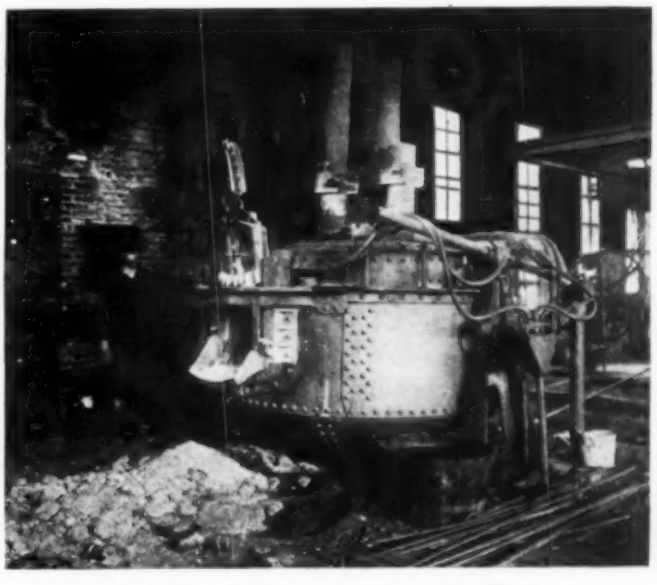


FIG. 1—STEEL IS MELTED IN A 1-TON ELECTRIC FURNACE

the possibilities of the electric furnace for melting, annealing and baking. Data were available to show what could be expected from the melting furnace. Less definite information could be secured in regard to what results might

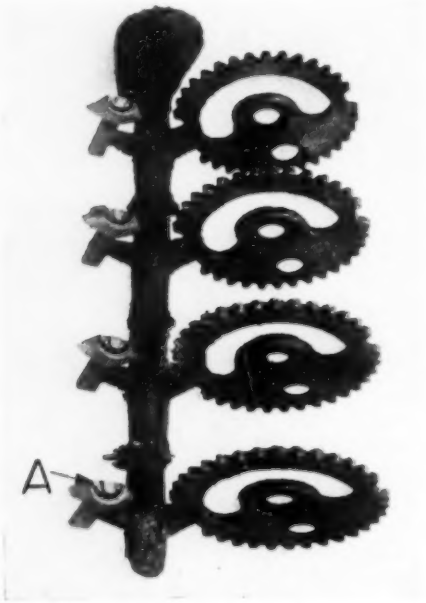


FIG. 2—A CORE ⅜-INCH THICK IS USED TO FORM A CURVED HOLE IN THE CASTING AT THE LEFT

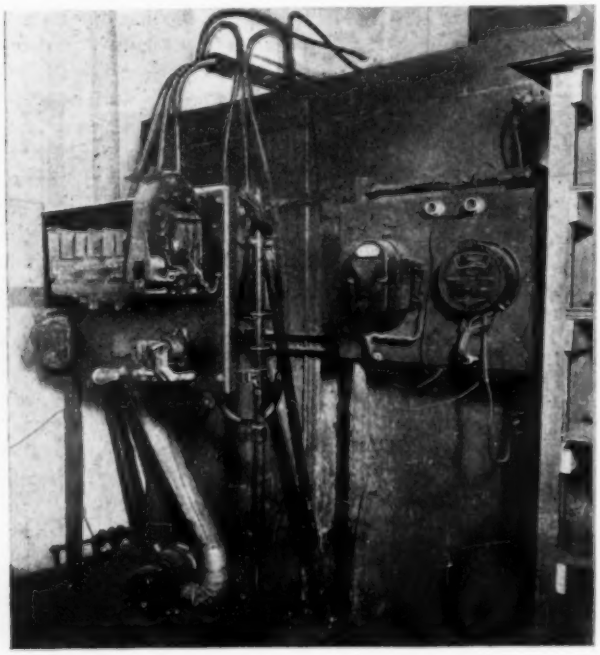
be obtained from the electdrical annealing furnaces, but the pit furnaces used during the war for heat treating gun forgings served as a basis for computing the power necessary for operating these furnaces. However, little accurate data were available to determine the best design and operating conditions for the mold-drying oven, nor could the amount of cores dried by a kilowatt hour of power be determined accurately. Three different sources where information on this point was available disagreed materially and Mr. Emery had to estimate the power to be required from what figures were furnished him from these disagreeing sources. The Electric Furnace Construction Co., Philadelphia, which built the core oven and annealing furnace, guaranteed the oven to bake 13 pounds of cores per kilowatt hour. It has been found in actual practice that even with intermittent operation, 18 pounds of light cores are baked per kilowatt hour. Larger cores require more power for baking, and as the plant is new, an absolute standard of power consumption has not been determined.

It was decided to start on a small scale and work out the organization necessary to produce the high grade line of castings which it is intended to produce. A 1-ton electric melting furnace was installed. The Electric Furnace Construction Co., working with Mr. Emery, designed and installed the annealing furnace and the core oven. With all this electrical equipment, it is essential that current be obtainable at all times. Therefore, to avoid shutdowns owing to the power being off, two lines were run to the foundry from two distinct feeders which are in no way related to each other. Thus if one line is out of order, it is extremely unlikely that the other will be off at the same time.

Furnace Kept in Condition

The melting furnace, shown in Fig. 1, has a rated capacity of 1 ton as already has been noted. The control board for regulating the arc was made by the General Electric Co., and the meter panel was secured from the Westinghouse Electric & Mfg. Co. Fig. 1 shows the furnace on a Monday morning when the bottom has been repaired and made ready for the days run. A spare roof is kept in a pit near the furnace, covered with a wood platform. Thus, after the bottom is repaired in the morning, the heats can be run with a little patching between melts. Eight-inch carbon electrodes are used at present. The management saw little choice between the carbon and the graphite electrode. Both have advantages and disadvantages. While the electrical conductivity of the graphite electrodes is higher and a smaller electrode will serve when graphite is used, the cost of the graphite electrode is greater per pound and the heat conductivity is also higher. Figures secured did not show a marked advantage of cost in either of the two types of electrodes. An operating advantage claimed for the carbon electrode is that, being larger than the graphite electrode, it has an umbrella-like effect to protect the roof from the heat of the arc.

So far only two heats are taken off each day. Each heat requires about two hours. Succeeding heats would be melted in less time and if the furnace was operated continuously a heat could be taken out in little more than an hour and with considerably less electrical power. When greater production is required and several heats are made each day, the efficiency of the furnace will be increased considerably. Both plain carbon steels and alloy steels, including a 13 per cent chromium steel, have been made. Metal is shanked directly from the furnace



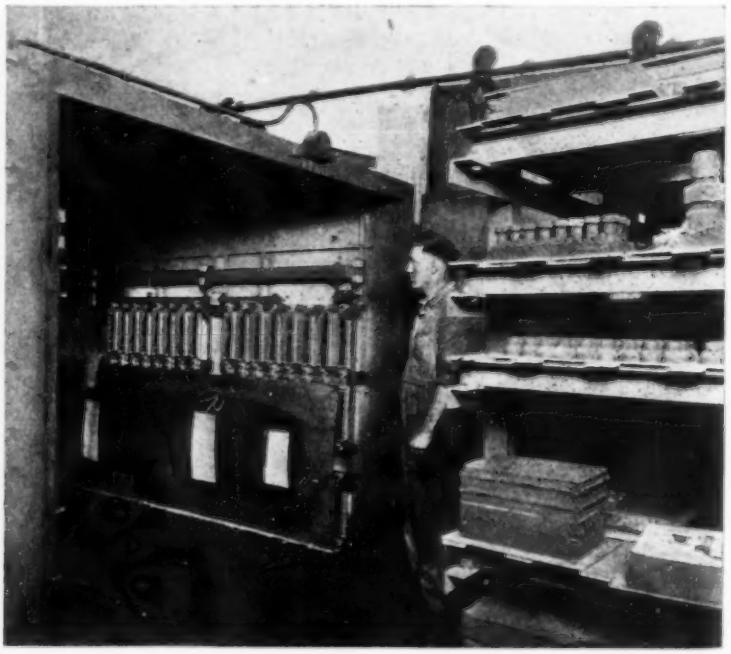


FIG. 3—ELECTRICAL CIRCUIT BREAKERS WITH A TEMPERATURE CONTROL PYROMETER AUTOMATICALLY REGULATE THE TEMPERATURE OF THE CORE OVEN FIG. 4—HEAT IS GIVEN OFF BY RESISTORS ON THE SIDES OF THE OVEN

for pouring into the molds which are arranged on the floor immediately around the furnace.

All the molds are dried. It is the opinion of the management that small molds should be dried, whereas a mold for a casting weighing 100 pounds or more would be made in green sand. However, it is not the intention to make castings as heavy as this. A local silica sand has been found which has a fine uniform grain and when mixed with a small proportion of clay and molasses water together with sea-coal facing forms a satisfactory mold. Great care is taken in preparing the facing sand mixture.

The molding and coremaking machines to be finally used have not been determined. A few counter-balanced, corebox-drawing machines and a jar-ram machine made by the E. J. Woodison Co., Detroit, have been installed, as well as two turnover, draw machines built by the International Molding Machine Co., Chicago. More molding machines will be installed to meet the varying requirements as the orders increase. The pattern equipment, of course, will be determined by whether the orders are for repetition work or for short orders, more expensive equipment being warranted by the former. So far, the volume of work has been mostly on small orders, but these orders have come from many parts of the country. Even one English firm which has a branch in this country found the Emery company could make a casting which it was unable to procure in England and has ordered a number of these castings for its English plant.

The main points to be observed in producing these intricate castings are to have the proper molding sand mixture; to take great pains to make each mold exact, and to pour the metal at the correct temperature when free from gas and slag inclusions. Some of the castings which are shown in Fig. 2, indicate intricate design of the work. As may be noted, these castings are made in a multiple mold; two castings in a section and four sections to the mold. The size of the sprue indicates that less than half the metal goes into the casting. The gear at the right is 5 inches in diameter and 3/16-inch thick. The casting at the left, which weighs about an ounce, is one of the most difficult the company has made. This is a plater for a knitting machine and requires a curved core, 3/32-inch thick at the point *A*. The core extends entirely through the head of the casting and is strengthened by two pins running perpendicularly to the curve. A slight excess of metal is added to the sides of the head and later is ground off. Even though this is

FIG. 5—MOLD FOR THE CASTINGS SHOWN IN FIG. 2—GREAT CARE IS REQUIRED IN SETTING THE CORE

an extremely expensive casting to make, when the price per pound is considered, the amount saved in not having to machine the hole cored out in the casting makes it cheaper than a drop forging would be. The mold, shown in Fig. 5, is 7 x 10 inches. The two indentations shown at the corners serve to locate the position of the section placed on top of it.

Electrically Heated Oven

As may be surmised, all the molds are quite small and comparatively easy to dry. However, it is highly important that they be dried uniformly and that the cores, or molds in one part of the oven are not baked harder than those in another section. This was one of the reasons which induced the Emery company to install an electrical drying oven. Another reason was oil could not be secured satisfactorily when the foundry was started and it is estimated that the cost of operation with either gas or oil would be as expensive as with electricity. On a small oven the expense of an attendant to watch the burner and temperature when firing with either gas or oil is high compared to the amount of molds dried; whereas, with the electric heating no attention is necessary after the car has been put in the oven and the doors closed. Coal or coke probably would be cheaper but it was questioned whether the temperature throughout the oven could be kept as constant or as uniform when using either of these fuels.

The inside of the oven is shown in Fig. 4, which indicates the type of resistors used. These resistors consist of resistance ribbon wound on insulators and divided into three circuits. One circuit consists of the two rows of coils at the top on the side of the oven. Another similar circuit is on the opposite side and the third circuit is composed of the lower coil on the two sides of the oven. The walls, roof and door are well insulated to prevent loss of heat. The rack of molds and cores is placed in the oven on a special spring-suspension, hand-lift truck.

When the door is closed and the temperature control thermometer is set, no more attention is required until it is time to remove the molds. The length of time required is being determined by experience and the oven will not be operated on the most economical basis until the correct time to allow the molds to bake is determined.

Fig. 3 shows the control and electrical equipment. At the right may be seen a temperature control instrument made by the Taylor Instrument Com-

FIG. 6—THE DRIED MOLDS ARE SPREAD OUT ON THE FLOOR NEAR THE MELTING FURNACE FROM WHICH METAL FOR POURING THEM IS SHANKED

FIG. 7—A RECORDING PYROMETER REGULATES THE TEMPERATURE OF THE ANNEALING FURNACE—THE CAGE IN THE CENTER IS USED TO HOLD THE CASTING AND IS COVERED BY THE CASE AT THE LEFT TO PREVENT OXIDATION

panies, Rochester. This instrument is attached to a thermocouple in the oven. The temperature is regulated by setting two pointers by a temperature scale on the upper face of the instrument. These pointers may be set as close together as desired, but the closer they are set the more frequently will they throw off and on the current, because when the temperature rises to the figure indicated by the pointer at the higher point on the scale, the circuit breakers will be thrown and the circuit will remain broken until the temperature of the oven falls to the point indicated by the lower pointer when connection again will be made. The Emery company sets the pointers at 450 and 470. Then when the temperature of the oven reaches 470 degrees Fahr. the circuit is broken and not connected until it falls to 450 degrees. Were the pointers set only 10 degrees apart, the circuit would be connected as soon as the temperature of the oven fell 10 degrees.

Lamp Signals Power Failure

On the instrument boards shown in Fig. 3, the kilowattmeter may be seen at the left of the temperature control meter. The circuit breakers are on the extreme left of the other panel. Below the circuit breakers may be seen a lamp. This lamp burns as long as there is power at the panel. Should the power go off at any time, the lamp will indicate this fact to the foreman. Without a free circulation of air, the moisture from the cores would remain in the oven and, with a damp atmosphere, it would be difficult to dry the molds thoroughly. A fan, direct connected to a small electric motor, is provided to overcome this as shown at the bottom of Fig. 3. The efficiency of the oven depends to some extent on the operation of this fan. If too much air is passed through the oven, the cooling effect is excessive; while if not enough air is circulated the cores will dry slowly. Another device for assisting the circulation of the air in the oven is the sheet-steel plate placed at the lower portion of the resistors, as shown in Fig. 4. This forms a draft and also protects the molds from the direct radiation of heat from the resistors.

Mark Pattern Numbers on Molds

Molds are brought from the drying oven to one corner of the foundry near the melting furnace and placed on boards for pouring. This is not an arduous task and two men spread out the entire heat in half an hour. The foundry clerk marks the pattern numbers of the castings in each on the mold so that he may know what is contained if it is not poured. After the heat is poured, the molds are dumped into the trough shown behind the clerk in Fig. 6. From here the sand is wheeled into the sand mixing room inside the door shown. Two mixers of the muller type are used. One mixes the facing sand and the other mixes the backing sand.

Castings are annealed in a new pit-type electric annealing oven designed and patented by Dr. F. W. Brooks, of the Electric Furnace Construction Co., the supplier of the oven. This style of oven was selected because it is desired to secure the annealed casting as free from surface oxidation as possible and to conserve floor space. The oven consists of a pit 40 inches in diameter inside the lining of firebrick, and 5 feet deep. The heating units are resistance ribbon wound on insulators similar to those shown in the

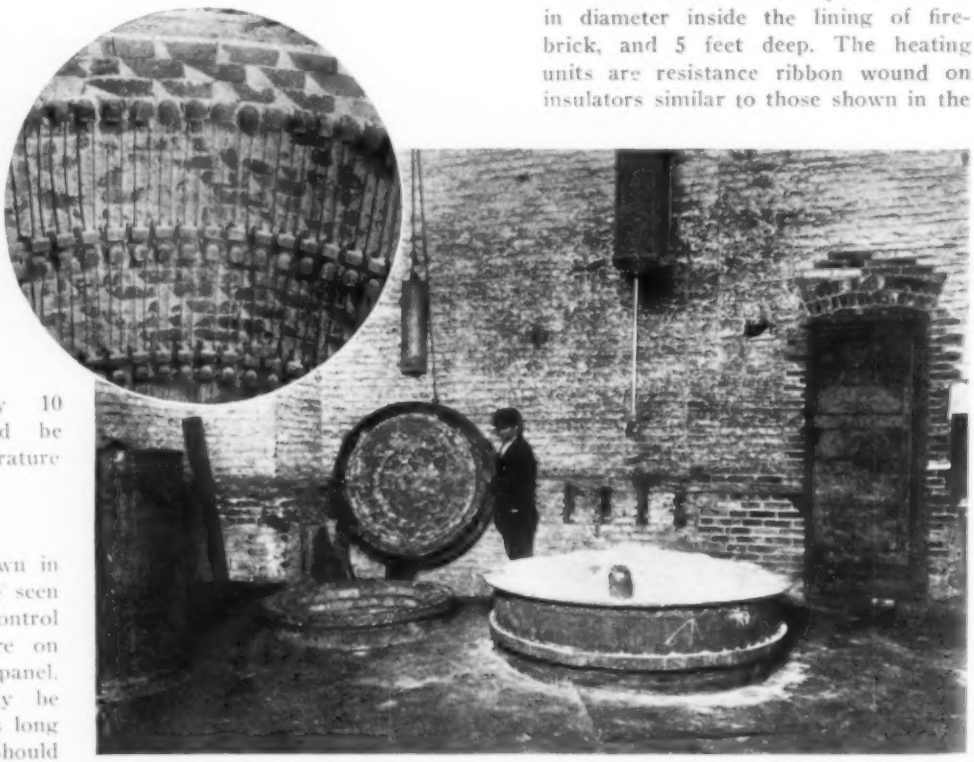


FIG. 8—TWO PITS ARE EMPLOYED FOR ANNEALING—THE ONE IS HEATED ELECTRICALLY BY RESISTORS SHOWN IN THE INSERT AND THE OTHER IS USED FOR SOAKING THE ANNEALED CASTINGS

insert, Fig. 8, were secured from the General Electric Co. This pit is closed by a brick-lined cover as illustrated to the right in the same illustration. The cover is secured by a hinge at the rear and is raised by an air hoist attached to the eye shown at the front. Heat is controlled automatically by an arrangement similar to that described for the drying oven. However, a different instrument is used for throwing the current on and off. This instrument, shown at the bottom of the panel in Fig. 7, also records the temperature on a chart which may be seen extending down from the bottom.

The instrument is built on the potentiometer system in which no current flows from the thermocouples located in the annealer, but the temperature at the two points is indicated by measuring the difference in potential at the ends of the two wires from each thermocouple. This system eliminates a possibility of trouble from a change of resistance in the circuit. Having two couples, the one near the top and the other near the bottom of the annealer the temperature of the oven at these two points is recorded. The desired temperature is indicated on the back of the panel in the instrument in a manner similar to the way it is regulated for the drying oven. At present the temperature is automatically maintained between 1620 and 1650 degrees Fahr. The contactors and circuit breakers may be seen on the panel above the recording instrument. The kilowatt meter is shown at the left on a separate panel. A record is kept of the time in and out, the power consumed and the anneal number, as well as of the weight of the charge.

Anneal Intermittently

The annealing oven has a rated capacity of half a ton but holds from 1100 to 1200 pounds of castings in a heat, so the furnace is not run continuously. In this way the furnace is comparatively cool when the charge is put in and four hours are required for the anneal. After the correct length of time has expired, the cover beside the workman in Fig. 8 is let down in the pit over the cage containing the castings, one of which is shown at the center, Fig. 7. Slots in the top of the cover allow the three lugs on the cage to extend through. A chain is attached to eyes in the lugs on the cage and the whole is lifted from the pit by the air hoist and transferred to the soaking pit to the left, Fig. 8. The cover is removed and the lid of the pit closed, swinging on a hinge and supported by a counterweight shown above. The castings are allowed to remain in the cooling pit the same length of time as is required for the anneal. When taken from the soaking pit the castings are below 800 degrees Fahr. The idea of the soaking pit is to enable the electrically heated portion of the furnace to operate continuously.

The efficiency of the electrical equipment will not be determined until the plant is on a normal rate of producton and will depend upon what is decided upon as normal. The rate for electric power is fixed by two factors, the total amount of power used and the highest amount required at any one time. This latter is what is known as the demand charge and is secured by taking the five hours which the recording watthour meter indicates as the highest for the month. The lowest and highest of these five readings are then discarded and the demand charge is based on the average consumption for the three other hours. If all the equipment was operated at the same time this demand charge would be high, therefore, at present the annealer is operated only at night when the melting furnace is not used.

The consumption charge rate is based upon the amount of power used, that is, the more power consumed during a month the lower will be the rate per kilowatt hour. Therefore, when the plant is operated more nearly on a steady basis, the power cost will be lighter for the amount of work accomplished. Another way in which the power cost will be lowered by more constant operation is in starting a heat or an anneal in a hot furnace. If the melting furnace were run continuously heats could be made with considerably less power than is required in intermittent operation. In the annealing furnace it is estimated that an anneal could be accomplished in three hours, instead of in four as is now required, if operating continuously. This would require more soaking pits or a means of cooling the single pit now used, as it becomes heated by the hot charge of castings and requires time to cool before a second charge can be placed in it. When this foundry gets on a stabilized normal operating basis, figures showing the power consumption of the several furnaces will be published in THE FOUNDRY.

The Ann Arbor Metal Products Corp., Ann Arbor, Mich., which recently was reorganized has resumed the manufacture of cast-aluminum plates and bronze gear blanks. James H. Collins of that city is trustee and manager. At present the company is occupying the leased premises of the Elwell Trolley Supply Co. and will continue to do so until a suitable site can be secured.

University Conducts Engineering Research

To assist in the conduct of engineering research and to extend and to strengthen the field of its graduate work in engineering, the University of Illinois, Urbana, Ill., maintains fourteen research graduate assistantships in the engineering experiment station. Two other assistantships have been established under the patronage of the Illinois Gas association. These assistantships, for each of which there is an annual stipend of $600 and freedom from all fees except the matriculation and diploma fees, are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering or applied chemistry.

The engineering experiment station, an organization within the college of engineering, was established in 1903 for the purpose of conducting investigations in the various branches of engineering, and for the study of problems of importance to engineers and to the manufacturing and industrial interests of the State of Illinois. Research work and graduate study may be undertaken in architecture, architectural engineering, ceramic engineering, chemistry, civil engineering, electrical engineering, mechanical engineering, mining engineering municipal and sanitary engineering, physics, railway engineering and theoretical and applied mechanics. The college of engineering also maintains a well equipped foundry in which gray-iron and alloy nonferrous alloy castings are made by the students.

Chicago Foundrymen's Club Elects Officers

Officers for 1921 and directors for 1921-22 have been elected by the Chicago Foundrymen's club. H. W. Ufer, Griffin Wheel Co., has been made president and John E. Schindler of the Garden City Foundry Co., vice president. George H. Manlove, Penton Publishing Co., is continued as secretary-treasurer. As directors for two years, the club chose C. F. Heywood, Burnside Steel Co., F. H. Blankenhorn, Chicago Steel Foundry Co.; A. W. Gregg, Whiting Corp., and Alex A. Stewart, American Brake Shoe & Foundry Co.

At the annual meeting 10 applications were accepted and plans were laid to enlarge the membership greatly, giving an opportunity for foundry foremen and superintendents to take advantage of the excellent series of talks and discussions offered.

Shows Trends in German Practice

Recent Meeting of the Iron Foundries Association Provides Opportunity to Present Ideas Which Have Been Developed in Molding and Metallurgical Practice

BY HUBERT HERMANNS

FOUNDED in 1870, the fiftieth annual meeting of the German Iron Foundries association which closed recently demonstrated some important trends in foundry practice. An equipment show was held in conjunction with the technical sessions, and many changes in machine design were noted.

One important device which was exhibited was a starting device for electrically driven compressors and pumps. This starter automatically cuts off and stops the compressor when the desired pressure is attained, and in event of a failure of the current, the starter is automatically disconnected until power again returns. It is stated that in a compressor with a suction capacity of 80 cubic meters per minute, a maximum pressure of 6.8 atmospheres, a running time of 6 hours 50 minutes and a stopping of 3 hours and 10 minutes, a yearly saving in current of 142,500 kilowatts is effected by means of this apparatus.

The authorities as well as the industrial trade associations in Germany lately have done exceedingly valuable work in counteracting the fuel shortage by as advantageous a utilization as possible of the available fuel. Foundry experts have instituted an advisory bureau for foundries, which functions in supervising the operation of cupola furnaces. In particular, a reduction of coke consumption is to be effected by an accurate and continuous measurement of air pressure and blast capacity. Other operations of this bureau deal with air heating and the proper conveyance of the heat of combustion against the foundry coke columns, with the enrichment of the heat of combustion by means of oxygen, and the utilization of the waste heat of furnaces and other fires.

A matter of great importance to the foundries is the adoption of furnaces for the use of low grade fuel, particularly lignite. The high percentage of water—50 to 60 per cent—in rough lignite militates against its use for drying purposes. It is suggested that the waste heat of drying chambers and cupola furnaces should be utilized for drying rough lignite. In many cases a more advantageous utilization of the fuel also can be secured by the distillation of the lignite in producers. The problem of the distillation of rough lignite has not yet been conclusively solved. In many foundries, where water power is available, this can be converted into electrical energy and the electric current employed for heating purposes.

Owing to the pig iron shortage German foundries are obliged in charging to work with a considerably higher percentage of scrap than formerly. Instead of high-silicon hematite iron, which now is scarce, ferrosilicon with a silicon content of from 10 to 12 per cent, produced in the blast furnaces, or ferrosilicon with a silicon content of as much as 90 per cent, produced in the electric furnaces may be used.

Unfortunately ferrosilicon has an extremely variable silicon content and, of late, a high sulphur content, amounting to 0.25 per cent and more. This gives rise to considerable difficulties in using it in the iron mixture. On the other hand, high grade silicon is of a uniform composition and free from objectionable secondary constituents. By a new process for the protection of the ferrosilicon while in the smelting furnace, against the oxidizing effect of the blast and the ascending gases, the ferrosilicon is crushed to a certain size and converted into hard briquettes with the help of a binding medium. Whereas briquettes made from the waste of pig iron castings are of use mainly in the casting of heavy and medium machine castings, it is possible by the addition of silicon briquettes to produce also faultless castings of the thinnest kind. A charge with silicon

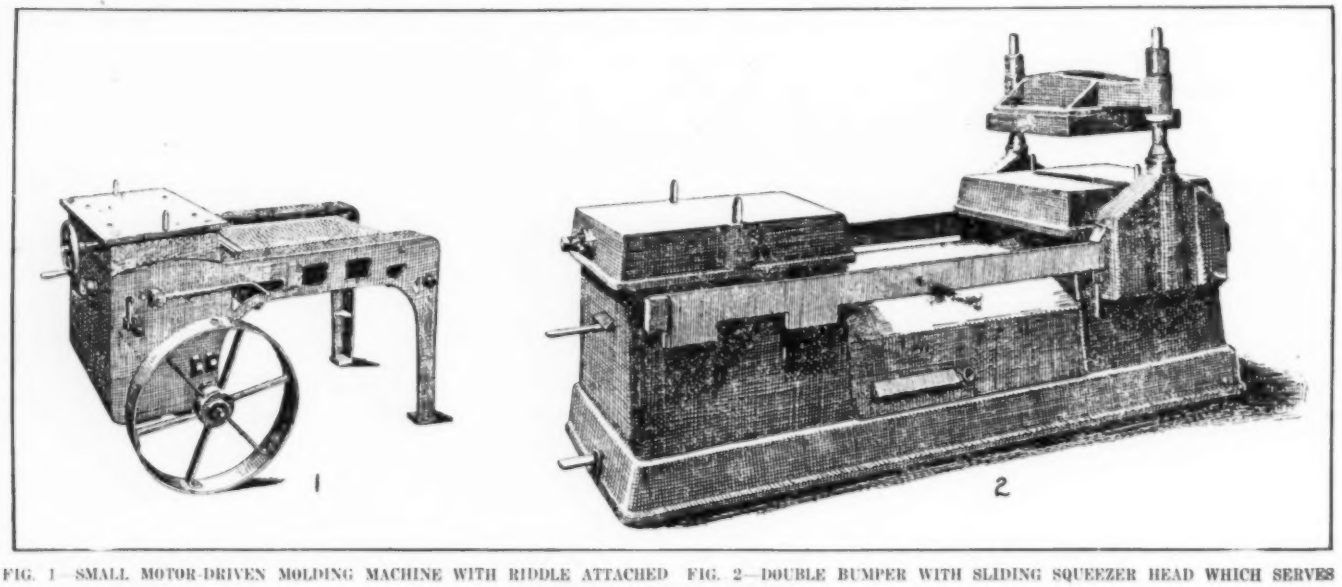


FIG. 1—SMALL MOTOR-DRIVEN MOLDING MACHINE WITH RIDDLE ATTACHED FIG. 2—DOUBLE BUMPER WITH SLIDING SQUEEZER HEAD WHICH SERVES BOTH ENDS OF THE MACHINE

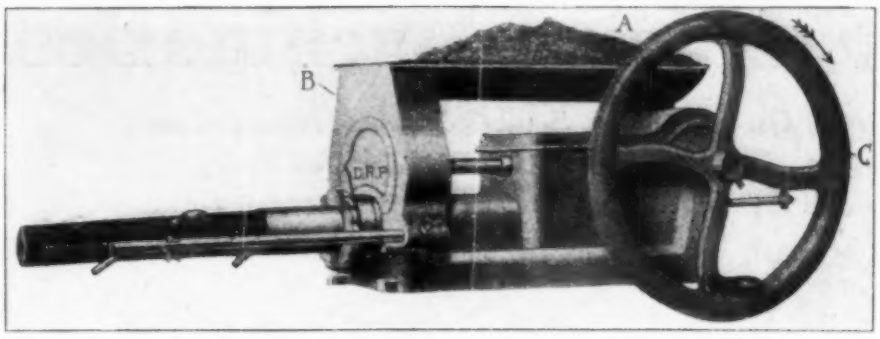


FIG. 3—SMALL HAND-DRIVEN MACHINE FOR MAKING PERFORATED CYLINDRICAL CORES

briquettes is given in the accompanying table.

Owing to the unfavorable economic conditions in Germany, the exhibition of foundry products in connection with the meeting was less varied than might have been expected under normal conditions. Nevertheless, a number of noteworthy innovations were on view. Among the molding machines exhibited, that with lifting carriage and combined riddle shown in Fig. 1, is worthy of note. The machine is easily portable and is driven by an attached motor. Deserving of mention, also, is the motor-driven double molding press shown in Fig. 2, in which the molding and lifting device for both ends is driven by one motor. Portable hand molding machines with accessory portable sand distributor and snap flask of profiled sheet metal also were shown by another exhibitor.

The core molding machine shown in Fig. 3, has an alternating piston, by which the wear and tear is considerably diminished. The air pin for the production of the air passage in the core is connected with the smooth-drilled hammer piston which passes through a conical guide bar. The throw of the pin can be accurately adjusted. The mode of working is shown in Fig. 3. The core sand is shaken from the shallow metal container *A*, into the feeder *B*. The flywheel *C* then is turned in the direction of the arrow, while the left hand is held before the aperture of the mandrel until the sand is carried sufficiently forward by the piston. The strength of the core can be regulated by holding the hand in front for a longer or shorter time to give the desired compactness.

The core-receiving and drying device for this core molding machine, shown in Fig. 4, is so arranged that the metal container can be used simultaneously as a drying plate, thus avoiding a special drying bed. The metal container is a fixed part of the machine.

Mixture and Analysis Table for Using Briquettes

Weight Kilograms.	Classes of Pig Iron.	Silicon Per Cent	Silicon Kilograms	Manganese Per Cent.	Manganese Kilograms	Phosphorus Per Cent.	Phosphorus Kilograms	Sulphur Per Cent.	Sulphur Kilograms
50	German I	2.50	1.25	0.60	0.30	0.60	0.30	0.100	0.050
175	Machine scrap	2.00	3.50	0.60	1.05	0.60	1.05	0.090	0.157
125	Furnace scrap	2.20	2.75	0.60	0.75	1.20	1.50	0.090	0.113
150	Sprues	3.00	4.50	0.60	0.90	0.80	1.20	0.150	0.225
			12.00						
	Loss	15%	1.80						
			10.20						
	5 Silicon briquettes		5.00						
	Estimated contents of charge . . .	3.04	15.20	0.60	3.00	0.81	4.05	0.109	0.545
	Estimated enrichment or loss . .			-0.12				+0.055	
	Estimated contents of casting. .	3.04		0.48		0.81		0.164	

Forms Alloy Research Association

An Alloys Research association is being formed with an alloys informational service as the first step. This is to be co-operative on the part of those interested in metals and their alloys. An advisory committee, composed of 17 prominent technical men, was formed some time ago and this committee has evolved a plan, in conference with the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers, whereby a service of a different scope from any now existing can be carried on for the benefit of those working with alloys. It has been felt that it is time to broaden the sources of knowledge and to have a co-operative service that will digest critically and analytically the great mass of data that has been accumulated, but is now largely inaccessible. Technical men have not the time to spend in searching even all of the current literature. It is planned to create a special scientific staff composed of a director and a corps of assistants who will give all their time to rendering a service of two distinct types: The first, current informational service, supplying information as to new results; the second, reference service, supplying as fully and promptly as practical all existing information relating to any phase of a subject. The board of managers, appointed by three of the divisions of the National Research council, is constituted of Alfred D. Flinn, secretary of the Engineering foundation, R. B. Moore, bureau of mines, and W. M. Corse, secretary of the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers.

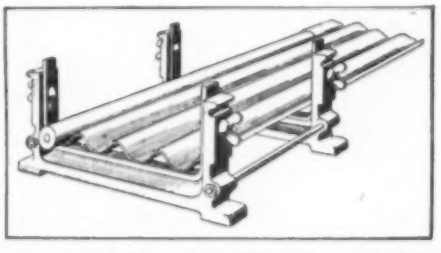


FIG. 4—RECEIVER AND DRYER FOR CYLINDRICAL CORES

The rights of members are specified in the provisional articles of agreement of the association as follows:

"Each member shall have the right to submit technical questions to the association and to have them answered as fully as possible from data available in the literature.

"Any member shall have the right to recommend specific reference work, and if the board of managers considers the recommendation of sufficiently general interest and importance it will be carried out by the association and the results made available to all members. If the work cannot be approved by the board of managers for investigation at the expense of the association the member proposing the undertaking still may have it carried out for his sole benefit, at cost including salary of the investigator, materials used, and a reasonable overhead charge to be determined by the board of managers."

The expense of the general service rendered by the association is supplied by the dues of the members which consists of a fee of $250 annually for a minimum period of three years.

Molding a Large Planer Machine Bed

Methods of Handling the Green and Dry Sand Cores Are Described in Detail Also the Precautions Observed To Prevent Distortion of the Casting While Cooling

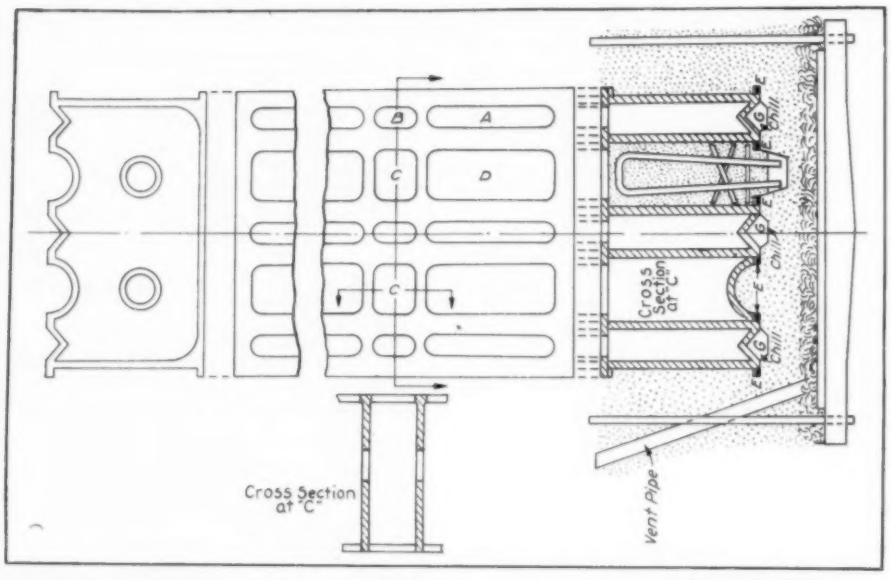
BY JOHN McMAHON

THE mold described here was made in a foundry near Manchester, England. The specifications called for a planing machine bed 30 feet in length by 6 feet 6 inches in width and 2 feet in depth. Not being equipped to make work of that size it became nesessary to make new rigging for the job. A number of binders 3 feet longer than the width of the pattern were made first, then a number of plates 1½ inches thick whose combined dimensions when assembled would cover an area approximately 32 x 8 feet were cast in open sand.

A hole was dug in the foundry floor about 3 feet 6 inches deep and large enough to leave a clearance of about 18 inches all around the pattern. The binders were spaced evenly on the bottom of the pit and leveled. The open-sand plates next were placed on the binders, then a layer of broken slag and cinders was spread over the plates and leveled off to a depth of about 6 inches.

Several sections of 4-inch pipe were laid up against the sides of the pit, one end resting on the cinders and the other end projecting above the floor level. A little hay was scattered over the cinders to prevent the sand from filling the interstices and thus interfere with the free outlet of the gases developed during the pouring operation. To prevent the casting from rising in the center while cooling, it was decided to allow ¾ inch camber in the sand bed; that is to have center of the bed ¾ of an inch lower than the ends.

The cores at *A*, *B* and *C* were made of dry sand, while at *D* the pattern left its own green-sand core. The points in the illustration marked *E*, indicate loose ribs running the full length of the pattern.



THE SMALL CORES INDICATED BY *A-B-C* WERE MADE IN DRY SAND AND SUSPENDED FROM THE COPE. THE LARGE CORES *D* WERE MADE IN GREEN SAND BY THE PATTERN ITSELF. THEY WERE LIFTED OUT ON PLATES TO FACILITATE THE FINISHING AND DRYING OF THE MOLD

Reinforcing the Green Sand

Places were located on the sand bed and a strickle employed to make prints for plates destined to lift out cores *D* after the pattern had been drawn out of the sand. A lifting plate as shown at *F* was made and placed in each print after which the pattern was set on the bed. Iron rods to reinforce the sand were employed freely in ramming up the green-sand cores and also on the exterior sand walls of the mold to prevent them from caving in.

Two copes were used to cover the pattern. A space about 12 inches wide across the center of the pattern could not be covered on account of projections on the ends of the copes. A plate coated with loam was employed to cover this space after the mold was closed. Since it was necessary to suspend the cores *A*, *B* and *C* from the cope, a number of hardwood wedges were placed under the bars of the copes and directly over the outlined prints showing on the top side of the pattern. The wedges furnished a firm foundation later when the cores were bolted to the cope.

After the copes were rammed they were lifted off, rolled over and placed on logs. The pattern was then drawn out on the floor and the cores *D* lifted out and placed on horses. Chills, 12 inches long to form the sliding ways shown at *G* were placed in position and the mold finished. Plumbago was rubbed in, slicked and washed over with molasses water. The chills were given a coat of wet blacking after which the mold was dried by a number of basket fires.

Cores *D* next were finished and blacked but not dried. They were returned to their respective places in the mold after it had been dried. Cores *A*, *B* and *C* were bolted to the cope before it was turned over and therefore had to be set very carefully. Taking the outside line of the pattern impression in the cope as a guide, a space corresponding to the thickness of the casting wall was marked off and a set of cores *A*, *B*, *A*, *B* placed in position and bolted through the cope. A thickness piece was laid parallel to *A* and *B* and another was laid between them at right angles to the first, and these served to locate cores *C*. This was done in every case, then all the thickness pieces were left in position until after the cope had been rolled over.

A number of clamps with long arms were made and fastened to the cope on one side; braces placed between the arms of the clamps and the cores held the latter in position while the copes were being turned over. The thickness pieces were then removed, the clamps taken off, the copes lowered on to the mold and the space between the copes covered by the loam plate. Binders were placed directly over those previously laid in the bottom of the pit and the copes bolted down firmly. The mold was

(Concluded on page 97)

Sand Plays Part in Poor Castings

Clean, Smooth Steel Castings Are Dependent Upon the Facing and Heap Sand Used—A Close Heap Sand Causes Blows—Ten Parts Heap Sand Mixed with One Part New Sand in Facing

BY R. J. DOTY

FEW foundrymen have not at some time felt that the effort of marketing their product would be considerably lessened could they always supply castings clean, smooth and free from interior defects. Some, aside from the sales problem involved, want to make steel castings better than they have ever been made before. All of us, for one reason or another, would make better steel castings if we could, and most of us are resolved to do so.

It is the purpose of this paper to present and discuss in a brief way, some of the problems which have a direct bearing on the qualities just referred to—problems which every foundry meets and contends with daily.

Given the best metal in the world, cast at the most suitable temperature, and provided with the most efficient means of feeding, it is impossible to get a clean, smooth casting, free from interior defects, unless you have a mold worthy to receive such metal. Without a mold you can have no casting, without the right kind of a mold perfect metal cannot give you a perfect casting.

It seems to me, therefore, that the problem which we must solve is making proper molds, and this is a much broader proposition than is at first apparent. It is more than molding, and the molder has control of but part of it. Briefly, it is correct molding with suitable facing and heap sand.

Facing and Heap Sand

Although much of the following may be of interest to those casting steel into sand molds, it is particularly written for those who do green-sand work and whose castings run from the lightest to one or two hundred pounds in weight.

All steel foundrymen will agree that a good facing sand must be strong, open or porous, and that it must peel well from the casting; but how many will agree as to the type of mill best suited for mixing this facing? Each type of mill has a following among steel foundrymen and every foundryman feels that his facing is good; yet how can this be if one type of mill is best?

Foundrymen also disagree as to the length of time a batch should be milled, and few equally know how long batches are milled. Some, in an effort to standardize, give instructions as to the number of minutes a batch should be run, but it is just as true that the operator depends more upon his judgment than he does upon the clock; that he will run it longer if he is not pushed by the molders or is tired, and will cut it short if pushed.

Disagree on Equipment

We are not, therefore, all agreed upon the type of mill best suited to our needs, nor upon the length of time a batch should be milled, but although some are getting better results than others we are all getting fair results and it is reasonable to assume that there is something more important to facing sand than the type of mill or the length of time it is milled. Let us see if it is in the ingredients of the batch.

Some foundrymen use crude sand, others washed and drained, a few washed and dried; some use sand from one district, and some from another; to some a sand is fine, to others it is coarse; and in the same manner they differ on the subject of fireclay.

It is not the intention of the writer to say that one sand is as good as another or that one clay is as good as another. There must be a best sand and a best clay. But how can we assume that one or a few of us are right and the rest wrong? There must be something which has a larger influence on our product than the different grades of sand and clay.

How many use the same proportion of new sand to old, or of clay to sand? How many use silica flour, and in the same proportion? How many use the same manufactured dry binder and in the same proportion? How many flour? How many the same liquid binder? How many molasses, water, or oil and in the same proportions?

Let the writer answer by illustrations. In Milwaukee there are 12 or more steel foundries. No two use the same mixture nor the same proportions. It was my privilege recently, to examine a comparison of the facing sands used by a number of foundries making small steel castings. The average weight of castings produced by these foundries is close and they manufacture castings for similar lines of industries. However, it would be well nigh impossible to find any similarity in their mixtures. The proportions of new sand to total batch varied from 10 to over 40 per cent, the clay and other ingredients varying likewise.

It would be difficult for anyone to say with certainty what are the best ingredients and best proportions to give the best results. However, that combination which is made of a good refractory sand and the least amount of binder, which, with just milling enough to thoroughly mix it and bring the strength of the binder into play, will give good results, is recommended.

The writer cannot designate the best mixture for any grade of work, but he can talk about a mixture which has given very good results under varying conditions and with different grades of silica sand and clay. The greater part of his experience has been with green sand castings and these castings have invariably peeled well, been free from scabs, etc. A large part of these castings were made in facing sand of which the following mixture is a fair example: Two hundred and sixteen quarts of heap sand, 24 quarts of new silica sand, 3 quarts of fireclay, 2 quarts of foundry flour and 4 quarts of silica flour.

Temper with Water

From time to time the proportions have been varied slightly, usually to offset the difference in the heap sand, but the results have been the same. The variation when necessary is in the ratio of old to new sand only. The standard mixture as shown has a ratio of nine old to one new. This ratio is decreased to open the facing but in no case has it been less than four to one.

This facing, like all others, will have to be watched carefully for two things: It must not be too wet nor too dry, and it must not be allowed to become too close. The matter of

Paper read at the convention of the American Foundrymen's association, Columbus, O. Oct. 5, 1920, by R. J. Doty, Siver Steel Casting Co., Milwaukee.

dryness will take care of itself, for should it become too dry it will be impossible to use it. Should it become very wet, the molders would refuse to use it, but it is possible to have it too wet for good results yet suitable for ramming. This condition can be prevented by careful training of the mill men and almost wholly prevented if the general foreman will make a practice of going to the mills to feel the sand at least once an hour, and if he will train himself and his assistants to take a handful of facing from occasional batches as they are delivered to the molders.

The matter of closeness is harder to watch but it is perfectly possible to know the condition of this sand by the sense of feeling and any foreman can soon train himself to recognize immediately a change in the openness of it. Until one has so trained himself, and as a check after he has done so, the following water test is reliable.

All foundrymen know that a handful of dry silica sand will take up water rapidly if it is allowed to fall on it drop by drop, and will continue until saturated. This is not because the sand absorbs water but because of the many little interstices between the particles of sand into which the water runs—in other words, its openness. They also know that a place on the surface of a mold made shiny by too liberal tooling is very reluctant to take water, and water applied to it will be absorbed very slowly, or, will even lie there in a thin film. They also know that a facing which is too close—or in other words, in which the interstices between the particles are reduced in size and separated from one another by dust—will absorb water very slowly. Bearing these facts in mind it is possible to judge openness pretty accurately, if one will take a handful of loose facing, and holding it in the palm and applying pressure strike it sharply against a smooth surface such as the handle of a wheelbarrow or a much used shovel. This will have the same effect as ramming and if the sand be moved back and forth along the handle it will give a more or less shiny appearance to the surface, such as tooling gives. Now, hold the sample in one hand with the smooth side up and inclined at an angle of approximately 45 degrees. From some container such as a can held in the other hand, allow water to fall rapidly drop by drop upon the sample. If one drop is absorbed before the next one strikes you may be sure that the sand is open and will vent freely, but should the water run down the surface spreading rapidly, it indicates that your sand is too close to permit a free passage of gases.

Seldom Loses Strength

The mixture given will lose its strength but it may become too close. It sometimes runs for as long as six months without a change and again it may be necessary to change it after a month or even a few weeks. This is probably due to the change in the character of work. A long run of light work where the ratio of facing to metal is high will result in the introduction of much unburned clay into the mixture, while a long run of heavy work where the ratio of facing to metal is low will result in the introduction of much burned and finely divided particles of clay and sand into the heap.

By carefully watching and testing, either of these conditions may be caught in time and the facing opened up by a reduction in the quantity of heap sand and an increase in the amount of new sand.

For convenience and accuracy in measuring, a 12-quart pail is used and the mixture already given, together with two other mixes calculated to open the facing will appear as follows:

	No. 1	No. 2	No. 3
Heap sand, pails	18	17	16
New silica sand, pails	2	3	4
Fire clay, quarts	3	3	3
Foundry flour, quarts	2	2	2
Silica flour, quarts	4	4	4

It is essential that the ingredients be accurately measured, and for the sake of those who use some form of power loader, it will be noted that in each mixture the quantity of sand is the same. Therefore, a removable partition may be so arranged in the loader bucket as to make a compartment which, when level full, will hold 20 pails. Then by introducing the new sand measured by pails, 2, 3 or 4 as the case may be, it will be evident that the heap sand may be shoveled into the bucket and measured automatically, as it is the difference between a total of 20 and the 2, 3 or 4 pails of new sand.

Spray With a Binder

Special attention is called to the fact that only water is used in tempering the mixture and that no liquid or dry binder other than those noted is ever used.

With sand such as this, the molds may be closed and poured immediately, or held for hours with equally good results, but should it be necessary to hold them open or, skin dry them, they would be sprayed lightly as soon as finished with weak molasses water, or some binder such as dextrine boiled with water, to prevent loose sand on the surface and corners. This loose sand always appears when a mold is allowed to dry in the air or when heat is applied. In spraying, care should be exercised to see that it is stopped before the surface takes on a wet or shiny appearance.

If this sand is kept open as it should be, the castings will not only peel well but they will be agreeably free from cutting and scabbing. It is equally true, however, that such a sand is not a preventative of cutting, scabbing, blow-holes or those minute dark holes which appear under the surface when a casting is machined, unless the heap sand and the molding are right. A sand such as we are considering will not cause such defects but it ought not to be called upon to prevent them inasmuch as the function of a facing is to provide a surface against which and over which metal at very high temperature may be run without fusing with the sand of which the mold is made.

To prevent cutting, scabbing, blowholes, gas pockets, and the minute dark holes which bother so many, we must have not only a proper facing but proper heap sand and correct molding.

In many foundries heap sand, if considered at all, is looked upon as a necessary evil, something with which to fill up the mold, and its preparation is left entirely to laborers. It seldom receives attention from a foreman unless some molder complains about it. Usually the molder talks to the laborer and the foreman knows nothing of it.

It is safe to say that little thought is given to the important bearing which heap sand has on our castings. A molder complains that it is "no good," and in reply to our question as to the trouble with it, states that it is "too wet" or "too dry." We send a laborer to cut some dry sand with it if it is too wet, or some water if too dry, but we seldom examine it to see just how it is, or stop to analyze its effect upon the castings.

Heap sand is nearly as important as facing. It must have sufficient bond to knit with the facing and to ram well. It must be strong enough to permit of lifting the cope, of drawing the pattern and of meeting casting strains. However, it must be open or porous to permit of the free and rapid passage of gases and steam which are a sure result of the casting operation, and are the cause of scabs, blowholes, gas pockets, and those minute dark holes under the

surface, which have been previously mentioned.

Some time ago in talking with good molders about venting I learned that it was unnecessary for all the air in the mold was sure to rush out through the heads before the mold should be filled with metal. True, but what about the water in the sand, the air between the particles of sand, the gases formed during and after the casting operation? It is very evident that as soon as molten metal enters and fills the mold the sand in contact with that metal rapidly takes heat from the metal and transmits it to the adjoining sand. The sand in contact with the metal comes to a high temperature and the adjoining sand is likewise raised to a high temperature, the temperature of the sand at a given point depending upon the distance of that point from the casting and the size of the casting. Within a short time after casting this temperature has increased to above the boiling point of water, and to that point where binders burn. Briefly, the interstices between the particles of sand adjoining the casting become filled with steam, hot air and gasses, which soon build up pressure unless they find free passage to some other point.

According to a well known law, gases travel along the path of least resistance and in the case of a mold all paths lie through the sand of which the mold is made. Picture to yourself a pocket of gas, increasing in pressure at a short distance from the molten metal but from 4 to 12 inches from the bottom board or the top of the cope. The pressure will force the gas to move, and following the law referred to, it will move toward the metal which is nearer unless the mold is a proper one, because the distance it must travel to find relief is shorter or in other words the resistance is less.

Gases Follow Easiest Path

In the case of close sand it cannot move until the pressure is sufficient to overcome the resistance and since it cannot pass through the sand it must move it. As a result small explosions take place and portions of the mold surface are lifted off and we have a scabbed casting.

In the case of a mold of good facing but poor heap sand the action is different. To follow out the reasoning in such a case, it is necessary to realize that molten metal offers less resistance to the passage of gases than does close sand. The good facing is open and readily permits passage of the gases. These gases enter the metal and almost always leave their mark. In many cases it is easy to find the point at which they entered; in nearly all cases the point at which they stopped in the casting is readily discovered. It is my belief that those minute dark holes just under the surface of a casting and which often appear as pin holes on the surface, are the channels through which gas forced by pressure sometimes, or by seeping through the open sand of the mold surface, entered the metal.

Using Vent Wire

In contrast let us consider a mold made from good facing and good heap sand. Such a mold will be very open. Metal enters under pressure from the sprue, the air is forced out through the heads where there are heads, and through the open sand were there are no heads. The temperature rises, the water is changed to steam, the hot air and the gases generated by combustion, expand; but since the path is clear they move slowly and gently through the sand, emerging along the bottom board or through the cope where they ignite. Such a condition is ideal and a pleasure for true foundrymen to watch, but it is a condition which rarely exists unless the good facing and good heap sand are helped out by correct molding.

In discussing molding we shall talk only of two things. One aids the gas in passing through the sand and the other has great influence on the smoothness of the castings. I will refer to venting first, since we have just been considering open sand.

In the best foundries sand cannot always be just right, nor can the molding be truly uniform. Should every mold be jolted or squeezed without any hand ramming it would not be uniform because it is seldom that the depth of sand over the entire surface of the pattern is the same and even were it uniform under this condition, we should still have deep pockets increasing the distance which the gases would have to travel and thus increasing the resistance to their travel. Realizing this we must help out our good sand and our good ramming by the use of a vent wire.

This vent wire, a simple and inexpensive tool, is but little used. Why, I cannot say. It requires little effort to push it through the sand if the end is slightly enlarged and in that shape it will not injure the pattern. It requires but a moment to vent the drag and scarcely longer to vent the cope if the heads and sprues are not removed until after its use. If we but put one one-hundredth part of the thought and effort on the vent wire that we expend on facing, we would be well rewarded. Our scrap piles will be smaller, our complaints and returns much less. Mediocre facing, poor heap sand and a good vent wire will accomplish wonders. Good facing, good heap sand and a good vent wire cannot be beaten.

Referring to the smoothness of castings, you have seen castings where a portion of the surface was smooth as glass and adjoining such smooth parts, or sometimes surrounding them, are surfaces which look like sandpaper. Sometimes you may have seen castings smooth everywhere but in the corners or on irregular surfaces. On surfaces horizontal in the mold you may have noticed that a group of shallow bosses were smooth while the castings between them were rough. In each case the entire casting was faced with the same sand and since part was smooth why should it not all be smooth?

Obtaining Smooth Castings

The casting was smooth where the mold surface was harder. On the flat surface the rammer may have come closer. It could not get in the corners and neither could it get over the irregular surface nor between the bosses. It does not take a molder long after riddling on this facing to tuck it firmly in pockets and corners and to press it with his hands over the surface of the pattern. It is worth while and will result in much smoother castings. This tucking of the facing firmly against the pattern is one of the greatest preventatives of cutting known to the writer, for with a facing sand such as we have been discussing, backed up by proper heap sand or proper venting, there will be seldom any cutting action by the metal in front of the gates provided that they are proportioned well. All good foundrymen know how to regulate gates. It has been my experience that cutting is almost invariably due to the fact that facing sand before the gate was not packed firmly enough.

Molding a Large Planer Machine Bed

(*Concluded from page* 94)

gated at *E*, *E* and poured at both ends, the metal entering all the ribs at the same time.

Two 10-ton ladles were employed to pour the mold. After the casting had set the ends were uncovered and the sand cleaned from around the gates to ease the contraction strain. Four molders made the first casting in a week, counting from the time the sand bed was made ready.

Inventor Installs His Own Devices

Equips His Entire Foundry with Suspended-Type Molding Machines and Uses Trucks and Pouring Device, All the Product of His Invention—Five-day Week an Innovation

GENERALLY an inventor who brings forth something new sells his patent because he can not use it himself, or he manufactures the article to sell to others. However, sometimes it happens that an invention is the product of a need in the shop with which the inventor is connected and in such cases the invention is tried in the inventor's own environment. This is the case with Eugene L. Howe, president and general manager of the Standard Malleable Iron Co., Muskegon, Mich., who has invented a number of foundry appliances and has installed them in his shop. A study of this foundry therefore is interesting as showing the adaptation of an inventor's ideas and also on account of several other unique features.

FIG. 1—A FOUNDRY EQUIPPED WITH SUSPENDED-TYPE MOLDING MACHINES IS CHARACTERIZED BY ROWS OF I-BEAMS WHICH SUPPORT THE MACHINES—AS THE FLOORS ARE FILLED WITH MOLDS THE MACHINES ARE MOVED TOWARDS THE WALL

The latest of Mr. Howe's inventions is a molding machine or to be more exact the adaptation of a molding machine through suspending it and carrying it along the molding floor. The construction of the equipment may be seen in Figs. 1, 2, 3 and 4. The molding machine proper is attached to a column carried on an I-beam which extends the length of the molding floor. The column is suspended by a bracket fitted with four wheels. As first adopted, this bracket had two wheels above the lower web of the I-beam and one underneath but it was found that the new arrangement gives better service. An arm extends to the side underneath the molding machine and supports a bench which travels with the machine on two wheels arranged in tandem, *A*, Fig. 2. This bench serves to carry cores and the flasks and pattern plate together with any small tools the molder may require. Another bench, *P*, Fig. 2 is used to carry the sieve.

No Special Machine Required

All the installations in the Standard Malleable Iron Co.'s foundry are equipped either with benches or squeezer machines manufactured by the Federal Malleable Co., Milwaukee, but any squeezer can be mounted on the traveling column. When the equipment is being moved the greater part of the weight is borne by the I-beam and only a small weight rests on the two side wheels which travel on the floor and support the bench. These wheels have been increased in diameter over the wheels first used. At rest, the mechanism is supported mainly by two feet which are lowered from two cylinders operated under 80 to 90 pounds air pressure, while some of the weight of the side bench is sustained by the two wheels. These feet from the air cylinders steady the machine satisfactorily. The legs are raised for moving by pressing a lever, and then no part of the machine is near the ground except the two large wheels under the bench. With practically all obstruction from sand on the floor thus removed and the wheels on the I-beam equipped with roller bearings one man is enabled readily to move the equipment along the molding floor.

The initial machine was built in July, 1919, and three days after it was first tried in the foundry the suggestion was made that an entire section served by one furnace be equipped with these machines. This was done and the advantages were found to be great enough to warrant the whole shop being supplied with the machines. A view showing a line of a few of the machines is shown in Fig. 1. In Fig. 2 the molder is preparing to make a mold. The pattern plate and flask may be seen on the bench to his left, while the riddle stands on the small shelf to his right. Fig. 3

illustrates a molder placing the finished mold on the floor and shows the short distance which the mold must be carried. Both of these figures illustrate the air squeezer type of machine, while Fig. 4 illustrates a bench machine. In all these illustrations it may be noted that the bottom boards are piled to the left of the molder and the sand is piled to his right. An air line also may be seen.

After the first furnace section was equipped with these molding machines the molders on the other floors saw the advantage of working with this system and requests were made by these molders to have machines installed for them. This was done as rapidly as possible and now all the floors are fitted with the suspended type machine, making a total of 95 machines operated in the foundry.

A detail of the operation of the foundry will illustrate the application of the machines. The molder, when he comes in the morning finds the sand in a windrow to the right of the machine and the bottom boards piled to the left. The machine is near the back of the floor and the molder starts to work placing the molds at the rear and gradually moving his machine towards the wall away from the center aisle of the foundry. As he moves forward the sand pile gradually is used so that the one end of it is always a little ahead of the molder, and the sand on each floor is so gaged according to the work that it is practically all used when the day's work is finished.

Two heats are taken every working day from each of the four furnaces. After pouring the morning heat the molder at once goes back to molding and foundry labor shakes out the molds. This work is done mostly by women who tilt the molds with a hook; lift the bottom boards and slip jackets, and pile them for the molder; then pick out the castings, placing them along the main aisle. The molds are dumped toward the center of the floor and the sand is allowed to lie until night. The molders go home after the last heat of the day and the night gang dumps the molds and cleans the floor, getting it ready for the molders in the morning. After the sand is wetted it is cut and piled in windrows by a sand cutting machine furnished by the American Foundry Equipment Co., New York. This machine goes over all floors and the work is finished before 3 o'clock in the morning. It thus may be seen that the molder only molds and

FIG. 3—WHEN STATIONARY, THE MAIN WEIGHT IS CARRIED BY TWO FEET PRESSED DOWN BY AIR CYLINDERS—THE MOLDER SIMPLY TURNS AROUND TO SET THE MOLD ON THE FLOOR

FIG. 2—A BENCH TO THE LEFT OF THE MOLDER CARRIES THE SNAP FLASK AND PATTERN AS WELL AS CORES WHEN NEEDED ON THE JOB

FIG. 4—BENCHES AS WELL AS SQUEEZERS ARE ATTACHED TO THE SUSPENSION DEVICE—SAND IS PILED IN A WINDROW TO THE RIGHT OF THE MOLDER

FIG. 5—WOMEN KNOCK THE CASTINGS OFF THE GATES INTO BARRELS OR TRUCKS—TRACTORS PULL TRAINS OF TRUCKS LOADED WITH CASTINGS TO THE CLEANING ROOM—A WIDE GANGWAY IS PROVIDED IN THE CENTER OF THE SHOP FOR THIS PURPOSE

pours, not having to cut or temper the sand.

A comparison with the former method of operation will illustrate the changes made by the introduction of the new machine. Probably the most striking change is in the decrease in the amount of work required by the molder who now merely turns around to set down the mold, whereas formerly he carried the mold a considerable distance, especially at the beginning of the day when it was necessary to deposit the mold at the rear of the floor. The Standard company has found that the molders now are able to put up a larger amount of work in a day owing to not having to do the arduous work of carrying the molds to the floor. A smaller loss of castings due to shifting of the mold also is noticed. When the molder became tired it was found that he allowed the mold to rest against his body while carrying it to the floor, but in the new method he does not become so tired, neither does he have so far to carry the mold, consequently there is less likelihood of shifted molds.

In the old method of handling the work the molder stood against the wall at the same place all day. After the morning heat the molds were dumped on a pile near the molder and the sand was tempered there for

FIG. 6—A CUPOLA FORMERLY WAS USED TO CAST ANNEALING POTS, BUT NOW POTS ARE CAST FROM OVER-IRON FROM THE DAILY HEATS—NOTE THE FAN IN THE CENTER OF THE ILLUSTRATION FOR COOLING THE FURNACEMEN

his use. Under these conditions a pile of warm sand was near the molding bench during the afternoon and to alleviate the heat an electric fan was set near each molder and used during the summer. With the new mode of operation no sand is dumped near the molder but he uses cool sand all day and moves away from the floor which is dumped in the morning. However, by not cleaning the floor until night a larger space is required. An advantage though is found in that, with the new way, if there is a shortage of laborers the molds do not need to be dumped until night.

Extra machines are kept on hand so that if it is desired to change a floor from machine to bench molding a bench rigging can be substituted for the machine and the shift can be made in about 15 minutes. This makes the method flexible and little difficulty is found in making such shifts as desired.

Special Core Oven

Cores are made in a separate building and carried to the molders on specially designed buggies with elliptical springs and motor-cycle wheels with pneumatic tires. One of these is shown to the right in Fig. 1. Draw-shelf ovens are used for the lighter, quick-drying cores. The heavier cores are baked in a two-compartment oven illustrated in Fig. 10. This oven has two racks which travel in and out on parallel I-beams. As may be noted the shelves are supported on steel tubes which extend through holes in the angular supporting columns. These holes provide means for adjusting the shelves at different heights. All the ovens are coke fired.

FIG. 8—AN ELECTRIC CHARGING MACHINE IS USED IN THE ANNEALING ROOM—THE SPACE ABOVE THE OVEN DOORS IS BRICKED AND LUTED DURING THE ANNEAL, BUT OPENED AFTER THE HEAT IS OFF TO HASTEN COOLING OF THE OVEN

The molding section of the foundry is a narrow, L-shaped building. This building is just wide enough to permit two molding floors, one on each side of a center gangway extending from the side walls to the center aisle. The one side is devoted entirely to molding machines, but the space on the other side of the gangway is shared between the molding floors and the four melting furnaces. These 10-ton air furnaces are equally spaced along the one side of the foundry. Stock and coal for the furnaces are kept in the storage yard immediately adjoining the building next to the furnaces Each car of pig iron is piled on a separate pile and not used until its composition is determined. This company uses charcoal pig iron and while this costs more than coke iron it is felt that enough advantages are secured through more uniform machining qualities of the product and less scrap castings to amply pay for the excess cost. The stock is brought from the yard on trucks pulled by tractors, and charged through the roof of the furnace by hand. Sprue is packed in boxes of 100-pounds capacity for charging. Coal is brought by wheelbarrows. The furnaces are tapped in order, starting with No. 1, and each furnace has certain designated floors for which it must furnish metal. Every heat is analyzed and tested for tensile strength and elongation. Scleroscope hardness tests also are made to determine whether the iron has been thoroughly annealed. The tensile tests show a strong ductile iron even though steel is not used in the charge. The high strength and ductility of the metal is attributed to the use of charcoal iron.

FIG. 7—METAL IS BROUGHT TO POURING STATIONS IN A SPECIALLY DESIGNED BUGGY LADLE—NOTE ONLY ONE HAND IS USED FOR POURING

New Pouring Device

A device invented by Mr. Howe is applied to the pouring operation. This consists of a bull ladle carried on trunnions by a two-wheeled buggy. The iron is tapped into the bull ladle and carried to certain stations on the floor for pouring into hand ladles. When it is desired to pour the metal from the bull ladle, the stock of the buggy is laid on the ground and the ladle is tilted on its trunnions by raising its handle as illustrated in Fig. 7.

Mr. Howe also uses another novel device for transportation in the foundry. This is the small truck made with two wheels at the back and a foot at the front, which can be hauled in trains by a tractor or can be moved singly by a two-wheeled carriage with a handle. These trucks are made with

FIG. 9—CASTINGS ARE BROUGHT TO THE CHIPPING DEPARTMENT IN TRUCKS WHICH ARE ARRANGED ALONG THE EDGES OF A PLATFORM FOR THE CONVENIENCE OF THE CHIPPERS WHO STAND ON THE FLOOR

either a wood or a steel body, and are used in the Standard foundry for transporting stock to the furnaces, as has been mentioned, and for moving the castings on their way from the foundry through the cleaning, chipping and annealing departments to the cleaning room. The extent to which they are used may be estimated when it is noted that the company has four tractors in service. One of these, purchased from the Clark Tructractor Co., Buchanan, Mich., is propelled by gasoline. The three other trucks are electric. Two of them were built by the Buda Co., Chicago, and one by the Mercury Mfg. Co., of the same city. One of them is shown in Fig. 5 drawing a train of four trucks filled with castings being taken to the cleaning room. Each truck will hold approximately 2000 pounds of castings or 3500 pounds of pig iron. As many as six trucks often are attached in a train and these trains follow the tractor closely in turning a corner, the rear truck usually turning within 6 inches of the track made by the tractor.

Women in the Foundry

When the castings taken from the molds and piled near the center runway become cool, women break them from the gates and drop them either into steel barrels or into trucks to be taken to the cleaning room, as may be noted in Fig. 5. The larger percentage of the castings are tumbled in one of the nine barrels arranged at such a height from the floor that the castings can be dumped from them into trucks. Two sand-blast barrels also are used. One of these is an inclined barrel which revolves slowly and serves to clean the more delicate castings.

From the cleaning room, the castings are carried by trucks to a raised platform in the center of the chipping room. The trucks are set beside each other in rows along the edges of the platform as may be noted in Fig. 9. The chippers then, standing on the floor, throw the castings either into barrels or into trucks to be taken to the annealing department.

Castings are annealed in 19 furnaces, 14 of which are small, having a capacity of 8 to 10 tons each, while 5 large ovens will each hold 20 to 28 tons of castings depending upon their shape. Each oven is equipped with two thermocouples connected with a recording instrument in the general office. The furnace tender has an indicating instrument with which he takes temperatures twice a day. The results he obtains are compared with the readings of the recording instrument. All the ovens are coal fired, and nine days are required to complete a cycle. Getting the oven to temperature takes two days; then the heat is held four days and the furnace is allowed to cool two days. Another day is required for unloading and recharging the oven. While it might be thought a cycle could be made quicker in the smaller ovens than in the larger ones, the Standard company finds that, if anything, a cycle in the smaller ovens requires more time than in the larger annealers.

Cooling the Annealed Charge

The electric charging machine is shown in Fig. 8, standing in front of one of the ovens which is cooling. As may be noted, there is an arched space between the doors and the furnace roof. This is filled with firebrick and luted during the anneal and the brick are removed about a day after the anneal to allow the oven to cool more rapidly. At present the electric cable conveying current to the machine is carried by five trolleys on wires on the side wall. A loop of cable extends between each trolley and allows freedom of motion to the truck. But even with this arrangement it is necessary for two men to carry the end of the cable next to the machine. A new system has been designed and shortly will be installed to carry the cable without the help of laborers.

Pots are carried to a separate room to be dumped after they come from the annealing furnaces. In this connection, it is interesting to note the

FIG. 10—ONE OF THE CORE OVENS IS EQUIPPED WITH SUSPENDED TRUCKS TRAVELING ON I-BEAMS INTO AND OUT OF THE HEATING CHAMBER

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

STANDARD SPECIFICATIONS FOR THE ALLOY: COPPER, 88 PER CENT; TIN, 10 PER CENT; ZINC, 2 PER CENT

1. (*a*) These specifications cover the alloy commercially known as government bronze, admiralty gun-metal, gun-metal, or 88-10-2 mixture, when used in castings.

(*b*) It is recommended that this alloy shall not be used where castings are subjected to a temperature exceeding 260 degrees Cent. (500 degrees Fahr.).

I—Manufacture

2. The alloy may be made by any approved method.

II—Chemical Properties and Tests

3. The alloy shall conform to the following requirements as to chemical composition:

Copper	86–89 per cent
Tin	8–11 per cent
Zinc	1–3 per cent

4. An analysis of each melt shall be made by the manufacturer. The chemical composition thus determined shall be reported to the purchaser or his representative and shall conform to the requirements specified in Section 3.

5. (*a*) The sample for chemical analysis may be taken either by sawing, drilling or milling the casting or tension test specimen and shall represent the average cross-section of the piece.

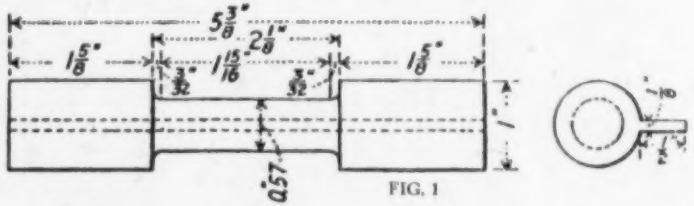


FIG. 1

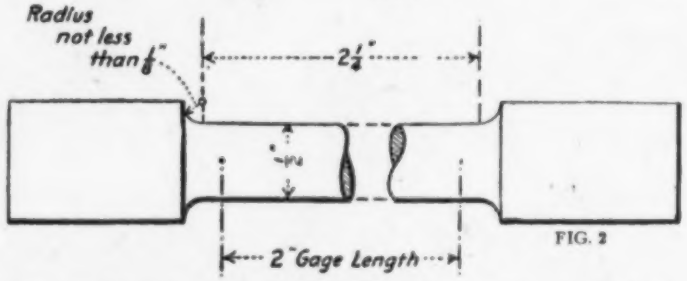


FIG. 2

Note:—The Gage Length, Parallel Portions and Fillets shall be as Shown, but the Ends may be of any Form which will Fit the Holders of the Testing Machine.

(*b*) The saw, drill, cutter or other tool used shall be thoroughly cleaned. No lubricant shall be used in the operation, and the sawdust or metal chips shall be carefully treated with a magnet to remove any particles of iron derived from the tools.

(*Continued on Data Sheet No. 368*)

Adopted by the American Society for Testing Materials, 1918.

The Foundry Data Sheet No. 367, February 1, 1921

STANDARD SPECIFICATIONS FOR THE ALLOY: COPPER, 88 PER CENT; TIN, 10 PER CENT; ZINC, 2 PER CENT

(*Continued from Data Sheet No. 367*)

III—Physical Properties and Tests

The alloy shall conform to the following minimum requirements as to tensile properties:

Tensile strength, pounds per square inch	30,000
Elongation in 2 inches, per cent	14

7. (*a*) Two test bars of the form and dimensions shown in Fig. 1 shall be an integral part of large castings, or cast separately in the case of small castings to represent a lot or melt and shall be molded in a manner similar to the castings which they represent. If the castings are heat-treated, the test bars representing such castings shall be similarly heat-treated.

(*b*) The manufacturer and purchaser shall agree whether test bars can be attached to castings, on the location of the bars on the castings, on the castings to which bars are to be attached, and on the method of casting unattached bars. Unless otherwise agreed upon, the minimum lot shall be considered as 500 pounds.

(*c*) Tension test specimens, turned from the test bar shown in Fig. 1, shall conform to the dimensions shown in Fig. 2. The ends shall be of a form to fit the holders of the testing machine in such a way that the load shall be axial.

8. (*a*) Two tension tests shall be made from each lot or melt.

(*b*) If any test specimen shows defective machining or develops flaws, it may be discarded; in which case the manufacturer and the purchaser or his representative shall agree upon the selection of another specimen in its stead.

IV—Inspection and Rejection

9. (*a*) Inspection may be made at the manufacturer's works where castings are made, or at the point at which they are received, at the option of the purchaser.

(*b*) If the purchaser elects to have inspection made at the manufacturer's works, the inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

10. Castings which show injurious defects revealed by machining operations subsequent to acceptance may be rejected, and, if rejected, shall be replaced by the manufacturer free of cost to the purchaser. The full weight of the original material rejected shall be returned to the manufacturer.

FIG. 11—A SEPARATE BUILDING IS EQUIPPED FOR RELINING LADLES—NOTE THE LONG OPEN COKE FIRE FOR DRYING THE RELINED LADLES

design of the pots and the instrument used to turn them over. This as shown in Fig. 12, is simply a long steel rod with a prong at the one end. To turn the pot the prong is placed over the edge of the pot and then when the handle is lifted the pot turns. The pots are cast with corrugations in the sides and ends. This is thought to increase the life of the pot by relieving strains on heating and cooling. After being annealed the majority of the castings again are cleaned in tumbling barrels or by sand blast. Pots formerly were made from cupola iron but now they are cast only when the furnaces have a surplus of iron above the amount required to pour all the molds on the floor, and any more pots which are needed are purchased. In this way enough metal can always be made to pour all molds on the floors without wasting any in case of a surplus.

The cupola formerly used for melting the iron for pots is shown in Fig. 6. This illustration also shows one of the melting furnaces. The electric fan in the center of the illustration and the hood, *A*, placed above the firing door to carry off the heat, indicate some of the measures which the company takes to make their employes as comfortable as possible.

The five-day week which this firm has instituted also is a step for the advantage of the workers. Some time ago it was decided to try the plan of working only five days a week, and after a short while it was found to be quite advantageous. The work days are 10-hour days so the molders who all work piece rate put in 50 hours a week, and some take advantage of the privilege of coming in an hour early in the morning to increase their production. The night gang works Saturdays instead of Friday night, and the foundry is put in thorough condition on this day, any odd jobs which have been postponed during the week being attended to then. Many of the molders drop in for an hour or so on Saturday and look over their floors and attend to any little adjustments which need to be taken care of to help them in production. Also by having two days every week to repair the furnace, no shut downs are necessary during operating periods, whereas when working six days a week a furnace was often shut down for a day or two during the middle of the week.

A novel feature of this shop is the building devoted to relining the ladles. This is a wooden structure located at a little distance from the main foundry building. An interior view, Fig. 11, shows some of the ladles which have been prepared for relining and the drying furnace. Hand ladles last through from 60 to 70 pours before it is necessary to reline them. When they can no longer be used they are brought to the relining house where the old lining is first knocked out of them and the inside of the bowl is lined with a mixture of fireclay and sand. This is dried by laying the ladle top-side-down on the furnace, which is a raised trough filled with coke on grate bars. After the lining is dry, the cracks which have developed in it during the process are filled with the clay mixture and a rim and skim spout are formed on it with the same composition. For doing this two molding benches have been set in one corner of the building and rigged to handle the ladles most expeditiously. The ladle again is dried on top of the furnace after the rim and skimming spout have been molded. The finished ladle is shown in Fig. 12 which gives a view of the clay-sand spout.

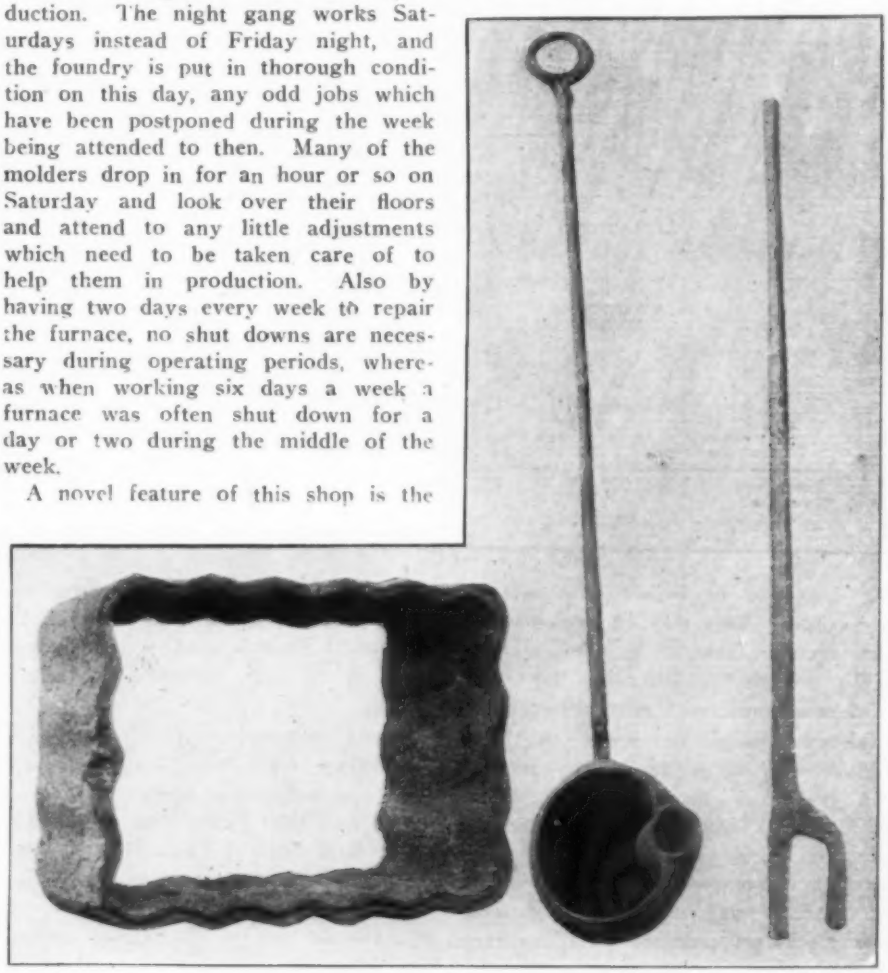


FIG. 12—THE ANNEALING POTS ARE CORRUGATED TO DECREASE THE EFFECTS OF HEATING AND COOLING STRAINS—THE PRONGED BAR IS USED FOR TURNING THE POTS—HAND LADLES ARE FITTED WITH SKIMMING SPOUTS

Analyze Loss in Aluminum Shops-IV

Tables Shown Detailing Casting Losses in Various Foundries on Different Castings — Percentages of Losses from Enumerated Causes Are Indicated in Case and Comparisons Are Made

BY ROBERT J. ANDERSON

FINAL effects of casting losses are measured in money value, and a decrease in the percentage of defective castings ultimates in increased profits. The indicated annual monetary losses in five foundries have been calculated on the basis of total output of finished castings, average casting losses, and cost of scrap castings. A summary of the factors affecting the losses in these foundries together with other cognate matter is tabulated in Table 1. It may be noticed that there is a tendency for casting losses to be higher with increasing output. This may be explained on the ground that it becomes increasingly difficult to supervise the work of larger numbers of men, although the tendency should be lower in large foundries than in small ones because the quality of the supervision should be better. Taking the five foundries listed in Table 1 on the basis of a total annual output of 29,220,000 pounds of castings and an average casting loss of 9.4 per cent, the total monetary losses amount to $385,309 per annum. This shows in a specific way the magnitude of the monetary losses in certain individual foundries as listed.

Table I

Monetary Losses and Other Items Compared

Foundry	Total annual amount of metal melted	Total annual output of finished castings, pounds	Kind of castings made	Metallurgical control	Quality of supervision	Melting and molding equipment	Quality of records kept	Average casting loss %	Annual monetary loss
A	13,250,000	9,500,000	Crankcases, largely; some other automotive parts	Fairly good	Good	Modern, good condition	Fairly good	7.0	$89,382
B	5,400,000	4,000,000	Miscellaneous automotive castings	Poor	Fair	Modern, good condition	Poor	10.0	$55,556
C	4,500,000	3,000,000	Miscellaneous automotive castings	Good	Good	Fair	Very poor	8.1	$29 374
D	1,420,000	720,000	Vacuum cleaner castings	None	Fairly good	Fairly good	Very poor	8.0	$15,652
E	18,000,000	12,000,000	Miscellaneous automotive castings	Fairly good	Good	Modern, good condition	Good	14.0	$195,345
Totals and Averages	42,570,000	29,220,000						9.4	$385,309

The data given in Table II have been furnished by various foundries, being obtained from the existing scrap records at the different plants. An attempt has been made to verify the accuracy of these data by personal inspection of the daily production of different castings at these foundries for periods ranging from several days to two weeks. Strictly accurate data in regard to casting losses are difficult to obtain, and the problem becomes more complicated in a foundry making a wide variety of castings, as in a jobbing foundry. So far as the foundryman is concerned, there is an economical limit beyond which it does not pay to go in collecting scrap records.

Losses incurred in the production of typical crankcases for both aircraft and automobile motors have been made available by several foundries.

The first item in Table II is a summary of the losses, covering five months' production at Foundry *A*, of a crankcase for a six-cylinder motor. The losses in this foundry were found to be reasonably low considering the size and complexity of the casting. A detailed examination of this data will throw light on the reasons for defective castings, and methods of prevention will suggest themselves. In this table and in the subsequent scrap-loss tables which are given, the average percentage of castings rejected for specific reasons has been calculated on the basis of the total number of castings rejected, and the total number of castings poured. For the crankcase in question, the total rejection for various reasons was 11.73 per cent, of which the main items were cracks, crushed molds, sand, runouts, misruns, core shifts, cores left out, cores set wrong, core sand, broken cores, core blows, broken in handling, and broken in chipping.

In classifying defective castings in foundries using a piece rate system of wage payment, defects are divided into two classes, allowable defects, and nonallowable defects. If a casting is scrapped because of an allowable defect, the molder will be paid for it, but if scrapped because of a nonallowable defect, he will not be paid. However, in some foundries the molder receives a certain percentage of the base rate pay for every casting produced whether defective or perfect. Re-

Table II

Casting Losses in the Production of Motor Crankcases

In Foundry A

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of allowable defectives	Number of not allowable defectives	Number of castings rejected because of specific defects: Cracks	Crushed	Sand	Cope drop	Run-out	Mis-run	Core shift	Core left out	Core set wrong	Core drop	Core sand	Dirty core	Broken core	Core blow	Broken in handling	Broken in chipping	Draws	Wet sand	Chill blows	Chill left out	Chill drop	Wet chill	Bad metal	Bad mold
Totals	53691	47391	6300	3333	2967	1257	447	278	107	250	269	518	235	260	39	434	60	204	179	863	536	64	152	2	12	6	8	114	6
Daily averages	483.70	426.95	56.756	30.027	26.729	11.324	4.027	2.504	0.964	2.252	2.423	4.667	2.117	2.342	0.351	3.910	0.540	1.838	1.613	7.775	4.829	0.576	1.369	0.018	0.108	0.054	0.072	1.027	0.054
						Average percentage of castings rejected because of specific defects																								
Based on the total number rejected						19.952	7.095	4.413	1.698	3.968	4.270	8.222	3.730	4.127	0.619	6.889	0.952	3.238	2.84113.699		8.508	1.016	2.413	0.032	0.191	0.095	0.127	1.810	0 095
Based on the total number poured						2.341	0.833	0.518	0.199	0.466	0.501	0.965	0.438	0.484	0.073	0.808	0.112	0.380	0.333	1.607	0.998	0.119	0.282	0.004	0.022	0.011	0.015	0.212	0.011

In Foundry B

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of allowable defectives	Number of not allowable defectives	Number of castings rejected because of specific defects: Cracks	Sand	Mis-run	Broken	Run out	Broken core	Core shift	Chill blows	Core blows	Wet sand	Totals
Totals	3037	2900	137	52	85	1	70	8	15	3	21	1	6	3	9	137
Daily averages	60.74	58.00	2.74	1.04	1.70	0.02	1.40	0.16	0.30	0.06	0.42	0.02	0.12	0.06	0.18	2.74
						Average percentage of castings rejected because of specific defects										
Based on the total number rejected						0.73	51.09	5.84	10.95	2.19	15.33	0.73	4.38	2.19	6.57	100.00
Based on the total number poured						0.03	2.35	0.26	0.49	0.10	0.69	0.03	0.20	0.10	0.30	4.55a

a. Subject to correction; about 2.5 per cent. should be added for losses not in the records and including rejections on the molding floor, in the core-sand and knock-out room and after welding The average loss is about 7.0 per cent.

In Foundry C

Rough Inspection Losses

	Number of castings poured	Number of castings accepted	Number of castings to be welded	Number of castings rejected
Totals	502	270	214	18
Daily averages	23.91	12.86	10.19	0.86

Average percentage of castings requiring welding..... 42.63
Average percentage of castings scrapped..... 3.59

Final Inspection Losses

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of castings rejected because of specific defects: Core shift	Cracked in welding	Broken in handling	Core blows	Cold shut	Sand and sand holes
Totals	1761	1689	72	28	16	5	14	6	3
Daily averages	50.31	48.26	2.05	0.80	0.46	0.14	0.40	0.17	0.08
				Average percentage of castings rejected because of specific defects					
				Core shift	Cracked in welding	Broken in handling	Core blows	Cold shut	Sand and sand holes	Per cent.
Based on total number rejected				38.89	22.22	6.94	19.45	8.33	4.17	100.0 0
Based on total number poured				1.59	0.91	0 28	0.80	0.34	0.17	4.09

jections because of certain causes may be regarded as partly allowable and partly not allowable because of the difficulty in deciding whether the defect is directly due to molding or to some other factor. Thus in Foundry *A*, losses because of allowable and not allowable defects are classified as follows:

Allowable	Not allowable
Cracks	Crushed
Draws	Sand and sand holes
Inferior metal	Cope drop
Dirty metal	Run-outs
Broken on chipping	Core shifts
Broken on handling	Cores left out
Core blows	Cores set wrong
*Wet chills	Mis-runs
*Broken cores	Dirty cores
*Core sand	Core drop
	Wet sand
	Chill blows
	Hard and soft ramming
	Chill drop
	Chill left out
	Bad molds
	*Wet chills
	*Broken cores
	*Core sand

*Partly allowable and partly not allowable.

If the nonallowable defects are considered as avoidable, and the allowable defects as not avoidable the first section in Table II shows 52.9 per cent of the defective castings rejected because of nonavoidable defects and 47.1 per cent rejected because of avoidable defects. This indicates that the casting losses in this foundry could be reduced by about 50 per cent if the readily avoidable losses were eliminated.

Foundry B. Losses in the production of a crankcase for a six-cylinder automobile motor for a period of two

Table III

Casting Losses in Production of Motor Oil Pans

FIRST PAN IN FOUNDRY B

Date 1919	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of allowable defectives	Number of not allowable defectives	Number of castings rejected because of specific defects: Broke	Sand	Mis-run	Chill blows	Core shift	Run out	Totals
Totals	5029	4636	393	80	313	15	286	28	41	21	2	393
Daily averages	68.89	63.51	5.38	1.10	4.28	0.20	3.92	0.38	0.56	0.29	0.03	5.38
						Average percentage of castings rejected because of specific defects						
Based on the total number rejected						3.82	72.77	7.12	10.44	5.34	.051	100.00
Based on the total number poured						0.30	5.29	0.56	0.82	0.42	0.04	7.43a

a. Adding 2.5 per cent. for losses not included in the production records, the average loss may be taken as 10.0 per cent.

SECOND PAN IN FOUNDRY B

	Number of castings poured	Total number of castings accepted	Total number of castings rejected	Total number of allowable defectives	Total number of not allowable defectives	Number of castings rejected because of specific defects: Broke	Sand	Mis-run	Broken core	Core shift	Run out	Chill blows	Totals
Totals	3669	3504	165	69	96	30	86	35	4	5	2	3	165
Daily averages	63.26	60.41	2.85	1.19	1.66	0.52	1.49	0.60	0.07	0.09	0.03	0.05	2.85
						Average percentage of castings rejected because of specific defects							
Based on the total number rejected						18.18	52.12	2.121	2.43	3.03	1.21	1.82	100.00
Based on the total number poured						0.86	2.34	0.95	0.11	0.14	0.05	0.08	4.53a

a. Adding 2.5 per cent. for losses not included in the production records, the average loss may be taken as 7.0 per cent.

THIRD PAN IN FOUNDRY B

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of allowable defectives	Number of not allowable defectives	Number of castings rejected because of specific defects: Broke	Sand	Mis-runs	Totals
Totals	690	666	24	2	22	1	22	1	24
Daily averages	62.73	60.55	2.18	0.18	2.00	0.09	2.00	0.09	2.18
						Average percentage of castings rejected because of specific defects			
Based on the total number rejected						4.17	91.66	4.17	100.00
Based on the total number poured						0.14	8.9	0.14	3.47a

a. Adding 2.5 per cent for losses not included in the production records, the average loss may be taken as 6.0 per cent.

	Number of castings poured	Number of castings accepted	Number of castings to be welded	Number of castings rejected
Totals	599	335	222	42
Daily averages	28.52	15.95	10.57	2.00

Average percentage of castings requiring welding 37.06
Average percentage of castings scrapped 7.01

FINAL INSPECTION LOSSES—FOUNDRY C

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of castings rejected because of specific defects: Core shift	Cracks	Hard ramming	Core blows	Mis-run	Broken in handling	Cracked in welding	Totals
Totals	1099	1047	52	14	10	1	15	9	1	2	
Daily averages	47.78	45.52	2.26	0.61	0.43	0.04	0.66	0.39	0.04	0.09	
				Average percentage of castings rejected because of specific defects							
Based on the total number rejected				26.92	19.23	1.92	28.85	17.31	1.92	3.85	100.00
Based on the total number poured				1.27	0.91	0.09	1.37	0.82	0.09	0.18	4.73

Table IV

Casting Losses in Production of Motor Inlet Manifolds

IN FOUNDRY B

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of allowable defectives	Number of not allowable defectives	Number of castings rejected because of specific defects: Broken in handling	Mis-run	Sand holes and sand	Core blows	Core shift	Totals
Totals	545	336	209	193	16	1	24	16	93	75	209
Daily averages	21.80	13.44	8.36	7.72	0.64	0.04	0.96	0.64	3.72	3.00	8.36
						Average percentage of castings rejected because of specific defects					
Based on the total number rejected						0.48	11.48	7.66	44.50	35.88	100.00
Based on the total number poured						0.18	4.40	2.94	17.06	13.77	38.35

IN FOUNDRY C

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of castings rejected because of specific defects: Porosity	Core shift	Core set wrong	Core blows	Sand and sand holes	Shrink-age	Cracks	Mis-run	Totals
Totals	1838	1762	76	1	19	33	11	6	1	4	1	
Daily averages	65.64	62.93	2.71	0.036	0.69	1.18	0.39	0.21	0.036	0.14	0.036	
				Average percentage of castings rejected because of specific defects								
Based on the total number rejected				1.32	25.0	43.42	14.47	7.89	1.32	5.26	1.32	100.00
Based on the total number poured				0.05	1.03	1.80	0.60	0.33	0.05	0.22	0.05	4.13a

a. Adding 2.0 per cent. for rejections at the band saw and in grinding, the indicated average loss may be taken as 6.1 per cent.

months in Foundry *B* are summarized in the second section of Table II. While this crankcase was of fairly simple design, and the indicated losses are low, it is believed that about 2.5 per cent should be added to cover scrap castings rejected on the molding floor, in the core-sand knock-out room, and after welding. Although this would make the average loss about 7 per cent, this figure appears to be lower than what the actual loss is. However, the data are compiled from figures supplied by the foundry. Considering the actual figures, the rejections are due largely to sand, misruns, breakage, broken cores, and wet sand, with most of these rejections

Table V

Casting Losses in the Production of Housings

DIFFERENTIAL HOUSING IN FOUNDRY B

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of allowable defects	Number of not allowable defects	Number of castings rejected because of specific defects: Broke	Sand	Mis-runs	Cracks	Core shift	Totals
Totals	610	499	111	64	47	2	38	2	3	66	111
Daily averages	61.0	49.9	11.1	6.4	4.7	0.2	3.8	0.2	0.3	6.6	11.1
						Average percentage of castings rejected because of specific defects					
Based on the total number rejected						1.80	34.24	1.80	2.70	59.46	100.00
Based on the total number poured						0.33	6.23	0.33	0.49	10.82	18.20a

n. Night molding.
a. Adding 2.5 per cent. for losses not included in the production records, the average loss may be taken as 20.7 per cent.

FINAL INSPECTION LOSSES—DIFFERENTIAL HOUSING—IN FOUNDRY C

Date 1919	Total number of castings poured	Total number of castings accepted	Total number of castings rejected	Number of castings rejected because of specific defects: Sand and sand holes	Cracks	Porosity	Cracked on welding	Core shift	Core blow	Totals
Totals	436	416	20	6	2	1	2	1	8	
Daily averages	31.14	29.71	1.43	0.43	0.14	0.07	0.14	0.07	0.57	
				Average percentage of castings rejected because of specific defects						
Based on the total number rejected				30.00	10.00	5.00	10.00	5.00	40.00	100.00
Based on the total number poured				1.38	0.46	0.23	0.46	0.23	1.83	4.59

ROUGH INSPECTION LOSSES ON TWO DIFFERENTIAL HOUSINGS IN FOUNDRY C

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of castings welded
Totals	438	242	100	96
Daily averages	29.20	16.13	6.67	6.40

Average percentage of castings welded.....21.92
Average percentage of castings originally scrapped.....22.83

	Number of castings poured	Number of castings accepted	Number of castings to be welded	Number of castings rejected
Totals	554	151	276	127
Daily averages	30.78	8.39	15.33	7.06

Average percentage of castings requiring welding.....49.82
Average percentage of castings scrapped.....22.92

Table V

Casting Losses in the Production of Housings (Concluded)

CHANGE—SPEED—LEVER HOUSING IN FOUNDRY C

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of castings rejected because of specific defects: Cracks	Core blows	Core shift	Mis-runs	Sand and sand holes	Shrink-age	Bad core	Chill left off	Hard ramming	Totals
Totals	2587	2421	166	17	35	48	29	20	8	3	5	1	
Daily averages	76.09	71.21	4.88	0.50	1.03	1.41	0.85	0.59	0.24	0.09	0.14	0.03	
Based on the total number rejected				10.24	21.08	28.92	17.47	12.05	4.82	1.81	3.01	0.60	100.00
Based on the total number poured				0.66	1.35	1.86	1.12	0.77	0.32	0.12	0.19	0.04	6.43a

a. Adding 2.0 per cent. for rejections at the band saw and in grinding, the average loss may be taken as 8.5 per cent.

SWITCHBOARD CONTROL—SHAFT GEAR HOUSING IN FOUNDRY C

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of castings rejected because of specific defects: Cracks	Core shift	Broken in handling and cleaning	Cold shut	Core blow	Sand and sand holes	
Totals	2851	2785	66	25	12	14	5	5	5	
Daily averages	98.31	96.03	2.28	0.86	0.41	0.50	0.17	0.17	0.17	
Based on the total number rejected				37.87	18.18	21.21	7.58	7.58	7.58	100.00
Based on the total number poured				0.88	0.42	0.49	0.17	0.17	0.17	2.30a

a. Adding 2.0 per cent. for rejections at the band saw and in grinding, the average loss may be taken as 4.3 per cent.

because of sand. The number of non-allowable defects exceeds the allowable ones, and there is apparently considerable room for improvement in reducing losses due to avoidable causes.

Foundry C. Some data compiled from foundry production sheets for a crankcase for a four-cylinder truck produced in Foundry *C* also are shown in Table II. As will be recalled the inspection of large castings in this foundry is divided into two parts, rough inspection and final inspection. The indicated losses in the former were 3.59 per cent and in the latter 4.09 per cent, during one month, or on an indicated average loss of 7.68 per cent.

The above losses incurred in the production of motor-car crankcases are considerably lower than those experienced in the production of Liberty motor crankcases. *During the war, losses in the founding of both crankcases and oil pans for the Liberty motor were exceptionally heavy, being as much as 52 per cent.

Foundry B. A compilation of losses incurred in the production of an oil pan for a small six-cylinder motor truck is given in Table III. The average rejection of castings for various reasons was 7.43 per cent, but this

*Anon., Aluminum foundry molding losses analyzed, The Foundry, vol. 47, 1919, p. 416.

Table VI

Casting Losses in Production of Motor-Carburetor Bodies

IN FOUNDRY B

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of allowable defectives	Number of not allowable defectives	Number of castings rejected because of specific defects: Cracks	Sand	Broke	Mis-run	Core shift	Core broke	Chill blows	Totals
Totals	1989	1861	128	87	41	32	42	19	8	18	1	8	128
Daily averages	86.48	80.91	5.57	3.78	1.78	1.39	1.83	0.83	0.35	0.78	0.04	0.35	5.57
Based on the total number rejected						25.00	32.81	14.85	6.25	14.06	0.78	6.25	100.00
Based on the total number poured						1.62	2.11	0.96	0.40	0.90	0.05	0.40	6.44a

a. Adding 2.5 per cent. to the indicated loss for losses not included in the production records, the average loss may be taken as about 9.0 per cent.

IN FOUNDRY C

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of castings rejected because of specific defects: Core shift	Sand and Sand holes	Bad mold	Cold shut	Broken in handling	Totals
Totals	564	527	37	32	1	1	2	1	
Daily averages	56.40	52.70	3.70	3.2	.1	.1	.2	.1	
Based on the tota number rejected				86.49	2.70	2.70	5.41	2.70	100.00
Based on the total number poured				5.67	.18	.18	.35	.18	6.56a

a. Adding 2.0 per cent. for rejections at the band saw and in grinding, the average loss is about 8.5 per cent.

was said to be a high loss for the casting in question because a gang of green molders were being broken in on the day shift during the period of time covered by the data. The rejections are due mainly to sand, breakage, misruns, core shifts, and chill blows. Adding 2.5 per cent for losses not covered in the production sheets, the average loss on this job may be taken as about 10 per cent.

Losses in the production of a second oil pan of different design also are toward the end in Table III. Losses largely to breakage, sand, and misruns. Adding 2.5 per cent to the indicated loss, the average loss on this job may be taken as about 7 per cent. A few additional figures for a third oil pan in the foundry are given in Table III. The rejections, due mainly to sand, are 3.47 per cent, and if 2.5 per cent be added, the losses are about 6 per cent of the total number of castings poured.

Foundry C. Rough and final inspection losses in the production of an oil pan in Foundry *C* are given towards the end in Table III. Losses found in the former are 7.01 per cent and in the latter 4.73 per cent.

* * *

Table VII
Losses in Production of Miscellaneous Castings in Foundry

MOTOR FAN

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of castings rejected because of specific defects: Sand and sand holes	Core blows	Bad corea.	Broken in handling and chipping	Core shift	Shrinkage	Bad mold	Totals
Totals	1569	1497	72	3	10	7	2	47	2	1	72
Daily averages	78.45	78.85	3.60	0.15	0.50	0.35	0.10	2.35	0.10	0.05	3.60

Average percentage of castings rejected because of specific defects	Sand and sand holes	Core blows	Bad core	Broken in chipping and handling	Core shift	Shrinkage	Bad mold	Per cent.
Based on the total number rejected	4.17	13.89	9.73	2.78	65.28	2.78	1.39	100.00
Based on the total number poured	0.19	0.64	0.45	0.13	2.99	0.13	0.06	4.59b

a. Bad core, too thick.
b. Adding 2.0 per cent. for rejections at the band saw and in grinding, the average loss is 6.6 per cent.

SECOND MOTOR FAN

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of castings rejected because of specific defects: Cracks	Sand and sand holes	Core shift	Shrunk	Warped	Misruns	Core blows	Broken in handling	Broken mold	
Totals	5114	4944	170	35	5	78	1	41	3	4	1	2	170
Daily averages	269.16	260.21	8.95	1.84	0.26	4.11	0.05	2.16	0.16	0.21	0.05	0.11	8.95

Average percentage of castings rejected because of specific defects	Cracks	Sand and sand holes	Core shift	Shrunk	Warped	Misruns	Core blows	Broken in handling	Broken mold	Per cent.
Based on the total number rejected	20.59	2.95	45.88	0.59	24.12	1.76	2.35	0.59	1.17	100.00
Based on the total number poured	0.68	0.10	1.52	0.02	0.80	0.06	0.08	0.02	0.04	3.32a

a. Adding 2.0 per cent. for rejections at the band saw and in grinding, the average loss is 5.3 per cent.

CONDUIT UNION

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of castings rejected because of specific defects: Sand and sand holes	Shrinkage	Ground too deeply	Core shift	Cold shut	Broken in handling	Core blows
Totals	5196	4409	787	49	2	30	644	22	1	39
Daily averages	236.18	200.41	35.77	2.23	0.09	1.36	29.27	1.00	0.05	1.77

Average percentage of castings rejected because of specific defects	Sand and sand holes	Shrinkage	Ground too deeply	Core shift	Cold shut	Broken in handling	Core blows	Totals
Based on the total number rejected	6.23	0.25	3.81	81.82	2.80	0.13	4.96	100.00
Based on the total number poured	0.94	0.04	0.59	12.39	0.42	0.02	0.75	15.14a

a. Adding 2.0 per cent for rejections at the band saw and in grinding, the average loss is about 17.0 per cent.

Motor Inlet Manifolds

REJECTIONS because of defects in motor inlet manifolds usually occur because of the same general causes already discussed, but core shifts are likely to account for a considerable percentage of the losses, while cold shuts, because of thinness of the walls, may also be numerous. Porosity and leaks in manifolds and in carburetors may run high at times. Inspection for porosity is ordinarily made during a special test for this defect and losses for this reason were not tabulated in the production sheets made available at the various foundries at that time.

Foundry B. Scrap-loss data for a water-jacketed inlet manifolds cast in Foundry *B* are available. The job was just being put into production during the period of time covered by the figures in the first section, Table IV, and it was stated by the foundry foreman that the molding had not been worked out satisfactorily. On this job, the only defects charged to the molder were those due to sand. Losses averaged 38.35 per cent, and these are

found to be due mainly to core blows and core shifts.

Foundry C. Losses in the production of a motor inlet manifold in Foundry *C* also are indicated in Table IV. On small castings, the foundry officials estimate that a 2 per cent rejection takes place at the band saw and in grinding, so that the average loss on this job may be placed at 6.1 per cent.

* * *

Various Kinds of Motor Housings

ALUMINUM-alloy castings are used largely in automotive work in the form of transmission-gear housings, differential and clutch housings, and starting and ignition systems. Losses in the production of various kinds of housings vary widely with the type and design of the castings.

Foundry B. Losses in the production of a differential housing in Foundry *B* were 18.20 per cent, for a limited period of time, as shown in Table V. Core shifts and sand were the principal causes for rejections. Adding 2.5 per cent the losses may be placed at about 20.7 per cent.

Foundry C. Rough and final inspection figures for losses in the production of a differential housing in Foundry *C* are given in Table V. The indicated average loss on rough and finished inspection is 27.42 per cent. Losses in the production of a second differential housing in this foundry were 22.92 per cent, as shown in Table V, for the rough inspection; no final inspection figures are available. If the loss on final inspection of this casting be taken at about the same figure as that of the preceding one (4.59 per cent), then the loss may be placed at about 27.50 per cent.

Change-Speed-Lever Housing

Foundry C. Losses sustained in the production of a change-speed-lever housing in Foundry *C* are summarized in Table V for about two months' production. Adding 2 per cent for rejections not included in the table, the losses may be taken as 8.5 per cent.

Switch-Board Control-Shaft Gearing Housing

Foundry C. Scrap-loss statistics covering about one month's production of a switchboard control-shaft gear housing in Foundry *C* are given in Table V. From the table, the indicated losses are 2.3 per cent, but adding 2 per cent for rejections at the band saw and elsewhere, the loss may be taken as 4.3 per cent.

* * *

Motor Carburetors

CASTING losses in the production of aluminum-alloy carburetor bodies are likely to be extremely variable because of varying porosity specifications for these castings. The data in Table VI shows losses caused by rejections for visual defects, and porosity rejections are not included.

Foundry B. Figures for losses in the production of a motor carburetor body in Foundry *B* are shown in the first section, Table VI. Adding 2.5 per cent to the indicated loss, the average loss is about 9 per cent.

Foundry C. A few figures for motor-carburetor losses in Foundry *C* also are given in Table VI. Adding 2 per cent for rejections at the band saw and grinding wheel, the loss is about 8.5 per cent.

* * *

Miscellaneous Motor Castings

MOTOR Fan. Losses incurred in the production of a typical motor fan in Foundry *C* are summarized for a short period of time in Table VII. Adding 2 per cent to the indicated loss, the average probable loss is 6.6 per cent. Additional figures for a larger motor fan in the same foundry are given in the same table. The average probable loss is 5.3 per cent.

Wheel-Hub Caps. The first section, Table VIII is a summary of the losses incurred in Foundry *C* during a short

Table VIII

Losses in Production of Miscellaneous Castings in Foundry

WHEEL-HUB CAP

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of castings rejected because of specific defects: Sand and sand holes	Mis-runs	Bad mold	Core shift	Core blows
Totals	1928	1831	97	35	38	1	20	3
Daily averages	192.8	183.1	9.7	3.5	3.8	0.1	2.0	0.3

	Average percentage of castings rejected because of specific defects: Sand and sand holes	Mis-runs	Bad mold	Core shift	Core blows	Per cent.
Based on the total number rejected	36.08	39.18	1.0308	20.61	3.09	100
Based on the total number poured	1.81	1.97	0.05	1.04	0.16	5.03a

a. Adding 2.0 per cent. for rejections at the band saw and in grinding, the average loss is 7.0 per cent.

OIL-STRAINER COVER

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of castings rejected because of specific defects: Sand and sand holes	Mis-run	Ground through	Cold shut	Broken mold
Totals	2749	2522	227	83	5	2	5	132
Daily averages	211.46	194.00	17.46	6.38	0.39	0.15	0.39	10.15

	Average percentage of castings rejected for specific reasons: Sand and sand holes	Mis-run	Ground through	Cold shut	Broken mold	Per cent.
Based on the total number rejected	36.56	2.20	0.88	2.20	58 16	100.00
Based on the total number poured	3.02	0.18	0.07	0.18	4.80	8.25a

a. Adding 2.0 per cent. for rejections at the band saw and in grinding, the average loss is 10.25 per cent.

BEARING CAP

	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of castings rejected because of specific defects: Sand and sand holes	Cold shut	Shrink-age	Blows and blow holes
Totals	4017	3731	286	85	78	22	101
Daily averages	191.29	177.67	13.62	4.05	3.71	1.05	4.81

	Average percentage of castings rejected because of specific defects: Sand and sand holes	Cold shut	Shrink-age	Blows and blow holes	Per cent.
Based on the total number rejected	29.72	27.27	7.69	35.32	100.0
Based on the total number poured	2.12	1.94	0.55	2.51	7.12a

a. Adding 2.0 per cent. for rejections at the band saw and in grinding, the average loss is about 9.0 per cent.

Table IX

Casting Losses at Different Foundries Producing Aluminum-Alloy Sand Castings

Kind of casting	Made in foundry	Number of castings poured	Number of castings accepted	Number of castings rejected	Number of allowable defectives	Number of not allowable defectives	Indicated average casting loss, per cent	Probable average casting loss, per cent	Principal causes for rejection
Motor-car crankcase	A	53,691	47,391	6,300	3,333	2,967	11.73	12.00	Cracks, crushed molds, and broken in handling and chipping
Motor-car crankcase	B	3,037	2,900	137	52	85	4.55	7.00	Sand and sand holes
Motor-truck crankcase	C	2,263	....	....	....	....	7.68	8.00	Core shifts and cracked in welding
Motor-car oil pan	B	5,029	4,636	393	80	313	7.43	10.00	Sand holes and chill blows
Motor-car oil pan	B	3,669	3,504	165	69	96	4.53	7.00	Sand holes and mis-runs
Motor-car oil pan	B	690	666	24	2	22	3.47	6.00	Sand and sand holes
Motor-car oil pan	C	1,698	....	....	....	....	11.74	12.00	Core shifts and cracks
Motor inlet manifold	B	545	336	209	193	16	38.35	40.00	Core shifts and core blows
Motor inlet manifold	C	1,838	1,762	76	....	....	4.13	6.10	Core shifts and cores set wrong
Differential housing	B	610	499	111	64	47	18.20	20.70	Core shifts and sand holes
Differential housing	C	874	....	....	....	....	27.42	27.50	Sand holes and core blows
Differential housing	C	554	....	....	....	....	27.51	28.00	....
Change-speed lever housing	C	2,587	2,421	166	....	....	6.43	8.50	Core blows, core shifts, and mis-runs
Control-shaft gear housing	C	2,851	2,785	66	....	....	2.30	4.30	Cracks and broken
Carburetor body	B	1,989	1,861	128	87	41	6.44	9.00	Cracks, sand holes, broken, and core shifts
Carburetor body	C	564	527	37	....	....	6.56	8.50	Core shifts
Motor fan	C	1,569	1,497	72	....	....	4.59	6.60	Core shifts, core blows, and bad cores
Motor fan	C	5,114	4,944	170	....	....	3.32	5.30	Core shifts, warped, and cracks
Wheel-hub cap	C	1,928	1,831	97	....	....	5.03	7.00	Mis-runs, sand holes, and core shifts
Oil-strainer cover	C	2,749	2,522	227	....	....	8.25	10.25	Broken molds and sand holes
Bearing cap	C	4,017	3,751	266	....	....	7.12	9.00	Blows and sand holes
Cable conduit union	C	5,196	4,409	787	....	....	15.14	17.00	Core shifts, core blows, and sand holes
Averages							10.54	12.26	

run on wheel-hub caps. The average probable loss is about 7 per cent.

Oil-Strainer Cover. Table VIII also gives figures for loss as sustained in the production of an oil-strainer cover. With an indicated loss of 8.25 per cent and adding 2 per cent for rejections at the band saw and in grinding, the probable loss is 10.25 per cent.

Bearing Cap. Indicated losses in the production of a crankshaft-bearing cap, as shown in Table VIII, are 7.12 per cent. The probable average loss is about 9 per cent.

Conduit Union. Data covering losses incurred in the production of a small conduit union are shown in Table VII. The indicated loss is 15.14 per cent, and the probable loss about 17 per cent.

THE figures for losses incurred in the production of typical aluminum-alloy castings, as given in Tables II to VIII inclusive, are summarized for comparison in Table IX. The average indicated loss for the kinds of castings for which casting-loss records were available is 10.54 per cent, with a probable loss of 12.26 per cent on the basis of corrected figures. Losses in the production of various kinds of castings as reported by foundries unable to segregate the causes for rejections vary widely; some of these must be regarded merely as estimates, but the following figures have been furnished: 1.30 to 10 per cent, with an indicated average of 3 per cent for motor-starter and ignition castings; from 7 to 18 per cent, with an indicated average of 12 per cent for a variety of motor castings; from 1 to 16 per cent, and an average of 4 per cent, for sandcast kitchen cooking utensils; and from 2 to 20 per cent with an average of 11 per cent for vacuum-cleaner castings.

Referring to Tables II to IX, and to Table IX in particular, the predominant causes for casting losses are found to be traceable principally to molding. Thus, the main causes which led to casting losses in the foundries for which data have been reproduced, included sand and sand holes, cracks, crushed molds, core shifts, core blows, dirty cores, cores set wrong, and mis-runs.

The trend of losses in different foundries will be taken up in the next articles, the actual losses incurred, having been considered in preceding articles.

How and Why in Brass Founding

By Charles Vickers

Bearings Cast Too Cold

We recently cast some bearings weighing about 50 pounds, from a mixture of scrap and new metals. The bearings were poured from one pot of metal, and all machined nicely. However, when two were placed in service, one operated satisfactorily while the other seized the shaft after running a short while. This latter bearing was then removed and was scraped and fitted, but it failed a second time, and was scrapped. The other bearing, cast at the same time, was not subject to this difficulty. Can you inform us as to the cause of the trouble, and also tell us whether an alloy of copper, 88 per cent; tin, 8 per cent, and zinc, 4 per cent, is satisfactory as a bearing metal?

The question that naturally arises is, did other bearings from this lot give satisfaction when machined and put in service? If it did, and there was no change as regards methods of lubrication, this would indicate that the failure of the one bearing was due to some difference in the structure of the metal, occasioned by pouring it too cool. It is obvious that the first bearing poured would be cast when the temperature of the metal was considered to be correct. As it would take time to do this, the metal would be cooler for the next bearings with the result that the last of these castings might

fail to come sound under the skin. If the bearing which failed to give satisfaction had been broken, its fracture probably would have revealed copper spots. These unsound spots could then be blamed for the difference in the behavior of the two bearings. A careful investigation of all the circumstances attending the casting of the two bearings would have disclosed reasons why one was satisfactory and the other a failure. The alloy mentioned in the inquiry is not a good bearing alloy. It should be replaced by the following: Copper, 80 per cent; tin, 10 per cent, and lead, 10 per cent.

Cannot Melt High Zinc Alloys in Cupola

We have a number of manganese bronze propeller blades to cast weighing about 3600 pounds each, and the test pieces must have a tensile strength of not less than 70,000 pounds per square inch. Will you kindly advise us how to make this alloy and how to proceed to melt the same in a cupola lined to 32 inches? Also, can we use the returns, such as gates, heads, and other left over metal.

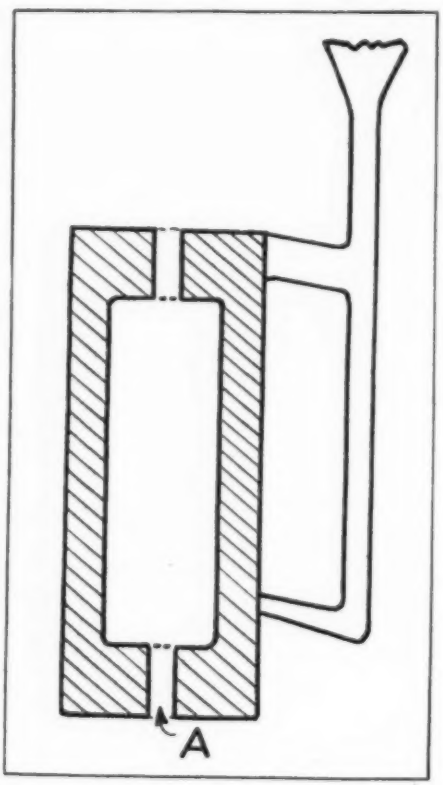
Manganese bronze cannot be made in a cupola furnace. The zinc content of a metal having 70,000 pounds tensile, must be in excess of 40 per cent of the mixture. Contact with the fuel as in a cupola would result in distillation of the zinc from the alloy causing heavy loss of metal and such a change in the composition, that a product less reliable than yellow brass would result. An oil-fired or gas-fired tilting brass melting furnace should be employed, and it will be advisable to install one especially for this work. The gates and returns can be used over again. All that is required is to replace the zinc lost by distillation when remelting such stock. The following alloy is the easiest to make: Copper, 46 per cent; zinc, 40 per cent; 30 per cent manganese copper, 12 per cent; aluminum, 2 per cent. Melt the manganese copper and the copper together, add the aluminum, then the zinc, pour into ingots and remelt the ingots for the castings.

Difficulties with Pump Plunger Cores

We are making phosphor pump plungers 21 inches long and 5 inches in diameter. The core is enlarged at the center of the plunger as shown in the sketch, which illustrates the cross section of the casting. The plungers are poured upright as shown and the difficulty is that the reduced section of the core at the bottom A, burns in solidly making it difficult to clean the castings and get a clean hole through at this point. The alloy is a phosphor bronze of approximately 90 per cent copper and 10 per cent phosphor tin. The castings weigh about 100 pounds, and to protect the core we have used a wash of plumbago, but this his been without result.

The core is permeated by the bronze at the bottom because the metal is forced into the pores by the pressure above the mold at this point. The remedy is to close the pores of the core at this particular point. This cannot be done by simply washing or painting it over with a plumbago wash as the coating sinks into the sand to a large extent instead of staying on the surface where it is required.

To protect the core, give it a preliminary coating of plumbago in the same



SECTIONAL VIEW OF PUMP PLUNGER

manner as before, then make a paste of plumbago by the use of a little molasses water, and rub this paste onto the core with the fingers and polish the plumbago like a stove, it is necessary to get a thick coating on the core, one the bronze is unable to penetrate. Then the core must be dried until warm, and the mold should be poured before the core can absorb sufficient moisture to dampen the rubbed-on coating of plumbago. It will not be necessary to coat the entire surface of the core with the rubbed-on plumbago; merely coat the parts where the metal has penetrated in the case of the castings so far made.

Alloy to Resist Moisture

Will you kindly advise us in regard to the composition of an alloy suitable for service in connection with apparatus subjecetd to moisture and ozone.

A number of different alloys including nickel alloys, aluminum bronzes, manganese bronze and phosphor bronze can be used and are available for this purpose. Probably the nickel alloys would be the most resistant to oxidation. The following alloy would be suitable: Copper, 65 per cent; nickel 32.25 per cent; aluminum, 2.75 per cent. It is the most difficult to melt and cast of any of the alloys that might be used. If the castings are small an aluminum bronze composed of copper, 89.50 per cent; aluminum, 10.50 per cent, would make nice, smooth castings. For a phosphor bronze use the following: Copper, 93 per cent; tin, 5 per cent; phosphor tin, 2 per cent. The last named alloy is the easiest one to work in a foundry, the next would be manganese bronze, then aluminum bronze, then the nickel alloy.

Babbittless Bearing

We would like to obtain a formula for a journal bearing metal that would not require babbitting. As a rule bearings are made from a metal consisting of copper 70 per cent; lead 20 per cent, and tin 5 per cent, but this metal must be babbitted with a white metal. What we want is an alloy for the bearing that will require no babbitting.

The following alloys have been used with success for street-car bearings without babbitting. For 3¼ by 7 bearings; copper, 60 pounds; lead, 40 pounds; tin 2½ pounds; for 4¼ by 8 bearings, copper, 62 pounds; lead, 35 pounds; tin, 3 pounds; for 5 by 9 inch bearings, copper, 65 pounds; lead, 30 pounds; tin, 5 pounds.

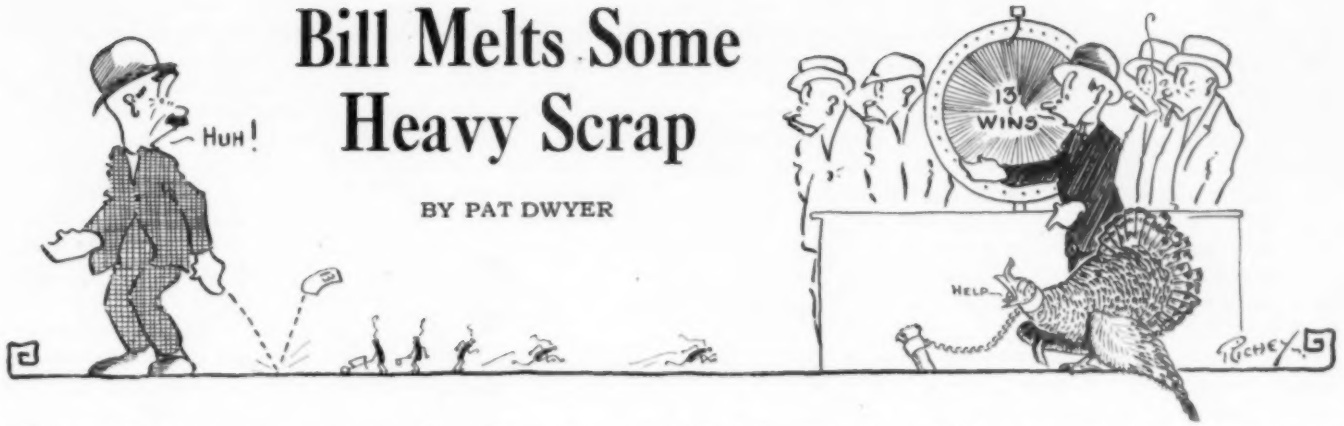
Brass for Conductors

We would like to obtain a formula for a brass suitable for casting large, round conductors. They should be as hard as bronze and at the same time easy to machine. Would you please advise us pose: Copper, 45 per cent; zinc 50 per if the following alloy will serve our purcent, and tin 5 per cent. We desire to use as much zinc as possible.

The alloy given in the query will be too brittle for the purpose outlined. An alloy of copper 57 per cent; zinc 42 per cent, and tin 1 per cent would be superior to the one given in the query. It may be necessary to add a little aluminum, perhaps about one ounce to the hundred pounds of alloy. This aluminum will act as a deoxidizer and will make the alloy more fluid, so it will be easy to handle in the ladle and cast.

Bill Melts Some Heavy Scrap

BY PAT DWYER

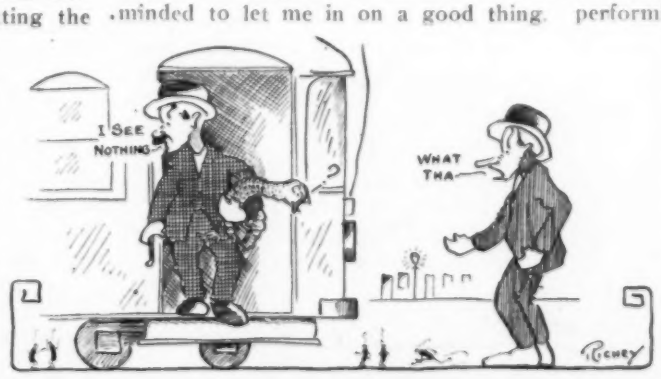


TAKING it by and large I suppose I have bought as many lottery tickets as the average citizen. Considering the net result on the same broad and liberal basis, I have won just as many prizes as that same well known person. All of which is simply another way of announcing that I still am working for a living. In these days of special amendments to the Constitution, vice crusades and all that kind of thing, a person cannot be too careful in his utterances. Therefore, to avoid any possible misconception, let me hasten to add that most of the tickets were bought with the laudable object of furthering some charitable cause rather than from any desire or expectation of reaping material gain. Is not one of the beatitudes worded somewhat to the effect that "Blessed is the man who expects little for he will not be disappointed?" Well, that's me.

It is quite probable that some person or persons benefited financially from these spontaneous outbursts of generosity; but as I have been at some pains to point out, I usually have failed to qualify among those present. I have no statistics by me at the moment; but I should be inclined to say, off-hand, that if all the money paid for tickets in lotteries and raffles in which I have participated, were collected in one sum it would bear a huge and striking likeness to the sum which slipped through the hands of the Emergency Fleet corporation during the time when it was putting the American merchant marine once more on the seven seas—and Hampton Roads. I have had tickets on gold watches, suits of clothes, and diamond rings; on every conceivable form of musical instrument from second-hand fiddles to grand pianos. I came near winning a young calf at one time though what I would have done with the beast if I had won it Heaven only knows, for I was *on the road* in those days.

The number of kits of molder's tools put up for the benefit of indigent brothers has been legion. There is a well founded belief that the number of cook stoves raffled off at the various molder's picnics held throughout the country during the year exerts a decided influence on the production of the stove foundries and helps to tide over those painful days known as periods of business depression.

A gifted young man craved my attention a few days ago and modestly intimated that he represented *Opportunity*. He touched lightly and skillfully on the biographies of some of the best known men of the present and past generation, showing how a small investment made at the opportune or psychological moment had been the first step on the road to fame and fortune. From this it was an easy transition to a brief monologue on the subject of luck and chance and the important part they play in our daily lives. He illustrated this point by those sterling if somewhat shopworn slogans: *Faint heart never won fair lady* and *Nothing venture, nothing win.* For a peroration he bitterly denounced the notorious h. c. l. and claimed that every man owed it to himself, his family and his country to take advantage of every opportunity to combat this nefarious state of affairs; or as he put it "Knock these here profiteers for a goal." He said that now he was happily in a position to help the good work along and owing to the high esteem in which he always had held me he was minded to let me in on a good thing.



WILD ANIMALS I HAVE KNOWN

With the experience of many years to guide me and the memory of many a dollar sent blithely on financial wild goose chases I instinctively felt what was coming and, therefore, was not unduly surprised when he told me that he represented a man who owned a flock of turkeys and that it was the intention of this philanthropic individual to raffle these turkeys off among a select and hand picked group of representative citizens.

Without any encouragement and in fact without pausing to secure an expression of opinion on my part he proceeded rapidly and briefly to sketch the method which had been adopted to carry out the idea of conferring this boon on the hand picked ones. A book of tickets numbered consecutively from 1 to 70 had been issued for each bird. As an inducement to the prospective investor, the tickets numbered from 1 to 10 were free; but as it manifestly was impossible for the turkey man to break even on that basis, the price of the tickets from 10 to 40 was set to correspond with the numbers. Thus if one drew ticket No. 35 he paid 35 cents for it and so on. No reasonable person will deny that the laborer is worthy of his hire and therefore the vendor considered he was conceding all that any reasonable man could expect when he offered the remainder of the tickets, that is from No. 40 to No. 70, at a flat rate of 40 cents each.

I never have been awarded medals or decorations of any description for performing feats of mental dexterity. The only effect of this harangue was to impress me that if I bought a ticket I should have one chance in 70 of securing a turkey; a condition referred to on the race tracks and other wicked places of a like character as a 70 *to* 1 *shot.* It also was apparent that I could not sink more than 40 cents in the venture. However, the possibility of drawing one of the free tickets removed any lingering qualms

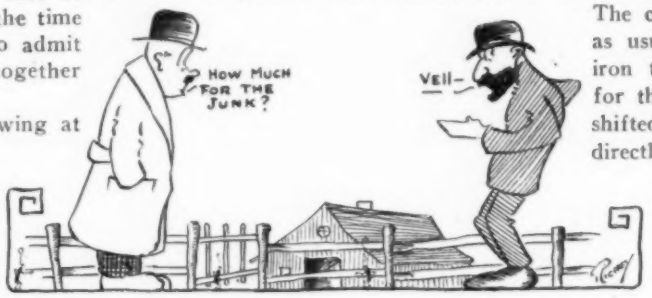
of conscience I may have had and I gallantly stretched forth one hand and drew No. 13. Later, when I had the time and the inclination two factors which do not always coincide, I got out a sheet of paper and was amazed to find that the sale of the tickets netted the turkey man $19. Even at the market rate of 75 cents a pound prevailing at the time for birds on the hoof, I had to admit that he was not actuated altogether by altruistic motives.

The eventful day of the drawing at length arrived and I was notified that I had picked a winner and would I call and get it. I would and I did. I went directly that night from the scenes of my daily toil and having secured the bird, tucked it under one arm and tried to look unconcerned as I sat in the car on my long ride home. The turkey evidently had been reared in a refined and gentle atmosphere. It behaved quietly and modestly and relieved me of all embarrassment. I confess I had looked forward with some apprehension to the ordeal of facing a car full of people with a kicking, plunging turkey under one arm; but I was happily disappointed. The turkey man thoughtfully wound about 6 feet of twine around the bird's feet and as I said before I had no trouble.

I was haunted on the way home by the uneasy fear that a band of thugs or gunmen might hold me up, perhaps on my very door step and take the prize away from me. Fortunately, just as I stepped off the car I met Bill who was on the way to my house. I told him of my apprehension; but he airily snapped his fingers and expressed his opinion that most of our troubles are imaginary and never come to pass.

"My motto is: It is time enough to shake hands with the devil when you meet him," said Bill. "I had charge of a little shop at one time in which the cupola was only 28 inches in diameter inside the lining. It was a general jobbing shop prepared to handle anything up to 3 or 4 tons. The iron charges were made up in the proportion of 1/3 pig iron and 2/3 scrap, that is machinery and stove plate scrap mixed in about equal proportion.

"The scrap was purchased in the usual way through junk dealers; but on one occasion the old man, who was just about as shrewd as they make them, secured at a bargain all the machinery and equipment of a pulp mill which had been damaged by fire. He had all the material hauled and piled in a part of the foundry yard, set apart for that purpose. Much of the equipment was reclaimed and placed in service again in various pieces of machinery made by the company. Finally, when everything usable had been culled out, the remainder was turned over to the foundry for scrap.



WHEN GREEK MEETS GREEK

"It certainly was great stuff and must have been made when pig iron was plentiful and cheap. In fact for the ordinary run of work, I used this scrap in lieu of pig iron in the mixture and for special jobs I used it alone. Many of the pieces were large and extremely difficult to break and as a result they were left until the last. There were several disks about 24 inches in diameter and 6 inches thick, having an estimated weight of 600 pounds. Other pieces were cylindrical in cross section, 12 inches in diameter by 4 feet long and weighed about 1400 pounds.

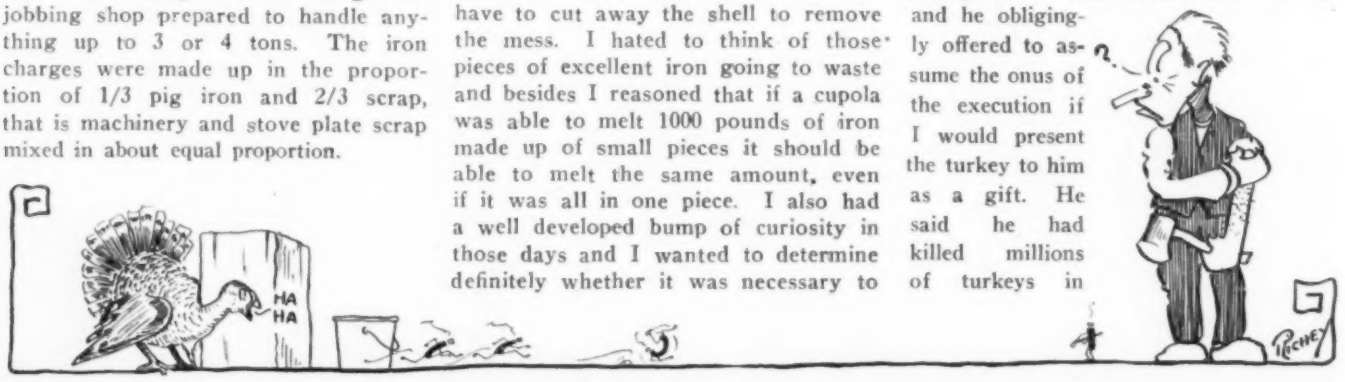
"Up to that time I never had seen a big solid lump melted in a cupola and when I proposed to melt these things I was told it could not be done. It was thought that the heavy lump of iron simply would crush its way down through the coke bed until it came to rest on the bottom doors. The result would be that the furnace would freeze up and I would be lucky if I did not have to cut away the shell to remove the mess. I hated to think of those pieces of excellent iron going to waste and besides I reasoned that if a cupola was able to melt 1000 pounds of iron made up of small pieces it should be able to melt the same amount, even if it was all in one piece. I also had a well developed bump of curiosity in those days and I wanted to determine definitely whether it was necessary to waste time and money breaking pig iron and scrap into small pieces before charging the cupola.

"We rigged a block and tackle and lifted one of the long pieces up to the charging floor. It was the worst looking piece of the lot and I was satisfied that if we could melt it, we would have no trouble with the others.

The coke bed was put in the cupola as usual, followed by one charge of iron then the coke was shovelled in for the next charge. At this point we shifted the block and tackle to a beam directly above the charging door and having hooked up the long piece of scrap managed by much maneuvering to slide it into the cupola. It was adjusted in an upright position in the center and held there until about 200 pounds of scrap was packed around the lower end. This was followed by the usual amount of coke for the second charge. In all, three charges of scrap and coke were employed to bring the last charge flush with the top of the long piece of scrap in the center and incidentally flush with the sill of the charging door.

"The wind then was put on and as the charge settled the remainder of the iron for the day's heat was charged as usual. The iron melted as calmly and quietly as if no liberties had been taken with the charging method and the furnace was perfectly clean when the bottom dropped. We handled the remainder of the big pieces in like manner. The disks were charged on edge and slipped through as easily as the long pieces. My heart was in my mouth for the first half hour of the initial trial; but it was needless worry and as I said before the same obtains in a great many cases."

We had by this time reached the house and the question of beheading the turkey was of paramount importance. Naturally tender hearted, the way the turkey had nestled confidingly under my arm on the way home made me loathe to cut short its bright young life. I mentioned this to Bill and he obligingly offered to assume the onus of the execution if I would present the turkey to him as a gift. He said he had killed millions of turkeys in



IT IS A MATTER OF COMMON KNOWLEDGE THAT A LEFT HANDED MAN SWINGS A PARTICULARLY WICKED AXE

his time and one more or less meant nothing to him.

I might have acceded to his request, you will notice that I said *I might;* but pressure was brought to bear from a certain matrimonial quarter, if you get what I mean, and I decided to keep it. The lady intimated that if Bill was such an expert turkey fancier perhaps he would be kind enough to give an exhibition of his skill in our back yard.

"Well," said he, "I am not quite as expert as Turkey Tommy the Terror of the Pampas who if we are to believe Ned Buntline could send his keen edged hatchet whizzing through the air and shear the head off a running turkey at 30 yards; but give me a short handled foundry bench ax and free elbow room and I bet I can cut his head off half an inch behind the ears." As the little boy sitting on the ice remarked "My tale is told."

Making a Pair of Composition Mounts

COMPOSITION mounts save time and expense wherever molds are made from patterns having an irregular parting line. Once formed in composition the parting line is permanently established. It will outlast any green sand match and can be made at less expense than a carved wooden follow-board or a metal plate. The various steps necessary to prepare a pair of pattern mounts, when using a compound made by the American Foundry Equipment Co., New York are shown in the accompanying illustrations. The material resembles molding sand and is manipulated like green sand to make the mold. However, it is said to harden overnight to a condition similar to hard fiber and requires no reinforcing. It is claimed that patterns made wholly or in part of this composition have withstood severe service for years.

Frames Protect Patterns

Malleable-iron pattern frames ½-inch thick, provided with pins and pin holes and countersunk screw holes have an undercut bevel that overlaps the edges of the composition and binds it firmly to the plate or pattern board. This frame and the board receive all the handling, rapping, etc., and protect the pattern from strain and abuse. Consequently patterns mounted by this method will last from five to ten times as long as similar patterns unmounted or simply handled as units.

The system is applicable to both wood and metal patterns in great variety and briefly may be described as follows:

One side of the pattern first is molded in composition and the parting line and runner formed. A transfer of this drag match then is made in composition, the latter forming the cope match. Then the pattern itself is set back into the first impression where it is fastened rigidly with suitable screws. It is not necessary to make a preliminary sand mold therefore there is no sand to clean off after the matches are finished.

The pattern selected for illustration is a small pulley. In Fig. 1, the drag

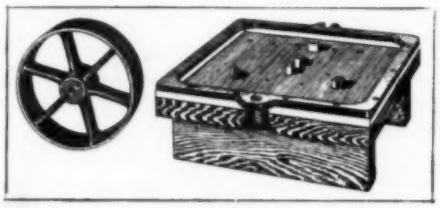


FIG. 1—FRAME AND BLOCKS IN PLACE ON BOARD

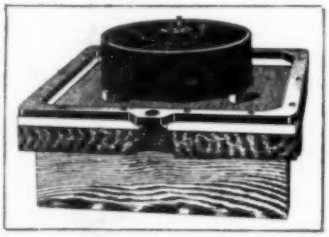


FIG. 2—PATTERN IS ATTACHED WITH SCREWS

FIG. 3—FRAME IS RAMMED FULL OF COMPOUND

FIG. 4—THE PARTING IS CAREFULLY SLICKED AND FINISHED

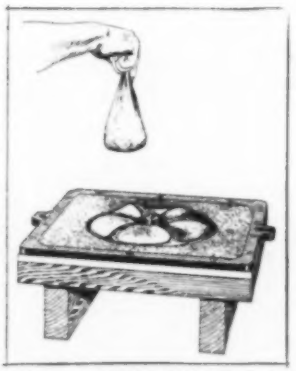


FIG. 5—TUMBLER DUST IS GOOD PARTING MEDIUM

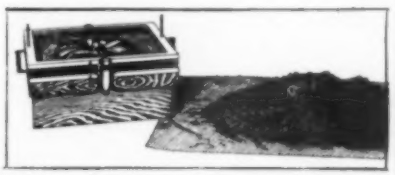


FIG. 6—COPE FRAME IN POSITION

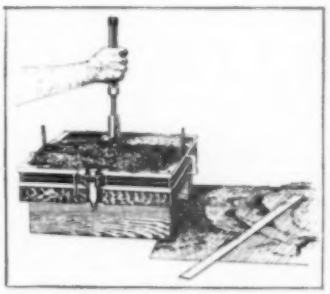


FIG. 7—THE COPE FRAME IS RAMMED FULL

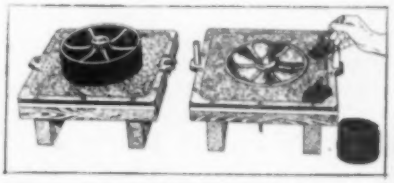


FIG. 8—THE SURFACE RECEIVES TWO COATS OF SHELLAC

pattern frame is secured to the board by an intermediate wood frame designed to bring the iron frame in proper relation to the parting line of the pattern. The pattern should rest level on blocks of end-grain, shellaced, hard wood to allow about ½-inch of composition beneath the lowest point of the pattern.

In Fig. 2, the pattern is shown attached firmly to the pattern board by a number of long screws which pass through the supporting blocks and enter drilled and tapped holes in the pattern. Small wedges will be found useful in locating the pattern upon the blocks in such a manner as will insure a clean, vertical draw. After mixing just a sufficient quantity of the compound, for the work in hand, the material is tucked and rammed under and around the pattern as shown in Fig. 3, until the frame is filled. The parting then is made as in ordinary molding practice.

After the parting is made, the pattern is unscrewed and removed. The blocks remain in the composition. The parting is gone over carefully and slicked, after which the match is set away to harden from 12 to 24 hours in a dry place at a temperature of 70 or 80 degrees Fahr. When the drag match has dried, the cope core-print is set in loosely for transfer to the cope match. The match face is dusted lightly with parting compound, through a fine bag as shown in Fig. 4. For this purpose, tumbler dust is recommended as it does not absorb oil and stick to the face of fresh mounts.

The cope pattern frame, the frame with the pins, is set in position on the drag mount and a wood frame of sufficient depth to accommodate the depth of the pattern is clamped on top of it. When all is ready as shown in Fig. 6, a fresh batch of compound is mixed and rammed in place, Fig. 7. The surplus material is struck off and the frame brushed clean, after which the cope pattern board is bolted on, the two parts turned over and the drag match removed. The cope match is then set away and allowed to harden over night. In Fig. 8 the pattern has been returned to the drag match and screwed fast permanently. For a finish, it is advisable to apply two coats of shellac varnish to the surface of the mounts, smoothing lightly with fine sand paper between coats.

Metal match plates and gated patterns readily are adapted for use on a two-plate molding machine by following the same procedure. The method produces a perfectly accurate pair of mounts without injuring or altering the match plate or card of patterns. Pattern mounts are equally valuable for bench, floor or squeezer molding. For such use the pattern merely is set, not fastened, into the drag match and no cope match is required.

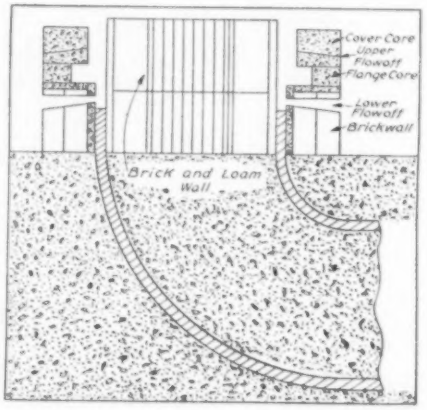
Burning a Flange Upon a 16-Inch Elbow

BY THOMAS NELSON

THE practice of repairing castings by the so-called *burning-on* process receives scant consideration in the majority of foundries and yet many seemingly worthless castings may be salvaged if the work is done carefully and in an intelligent manner. The method adopted for repairing the job shown in the accompanying illustration is a fair example of what was done in an apparently hopeless case.

After a 16-inch elbow pipe had been cast it was discovered that one of the flanges which should have been attached at an angle of 20 degrees in one direction was in reality pointing in the opposite direction. It was quite a job to make the casting as there was neither pattern nor corebox provided, nothing but a templet and two flanges. Under the circumstances the casting could not be replaced in less than a week and as usual in a foundry this one was wanted in a hurry.

It was decided to take a chance by cutting off the old flange and attempting to burn on a new one. The casting was taken to the machine shop where the pipe was cut off at the proper angle inside of the flange. This meant that about 3 inches of pipe would have to be burned on as well as the flange. The casting was taken back to the foundry and buried in a pit with the exception of about a foot of the cut end which was left projecting. The casting was so adjusted that the new flange would come perfectly level. Sand was rammed inside and outside the pipe to within 6 inches of the top. The inside was then built up with brick 4 inches higher than the proposed height of the pipe. A thickness of loam was



DETAIL SECTIONAL VIEW OF ASSEMBLED MOLD READY TO RECEIVE THE IRON

rubbed on the bricks and finished off to correspond to the inside face of the casting.

A brick wall also was built on the outside and a thickness of loam laid on the top to form the bottom face of the flange. Two holes were provided diametrically opposite each other and about an inch above the cut end of the pipe. These were to serve as flow-offs until it became certain that the end of the pipe was in a molten condition. The holes were tapered from 1¼ inces diameter at the face to 2½ inches on the outside.

A fire was built around the loam work and while it was drying two ring cores were made and placed in the oven to dry over night. One of these rings was the same thickness as the new flange plus ¼-inch for machining. The inside diameter of the ring corresponded to the outside diameter of the flange with, of course, the usual allowance for contraction. The second ring core was designed as a cope or cover core. The inside diameter of this ring was 2 inches greater than the outside diameter of the pipe. This was to provide a generous opening in which to pour the iron. The top ring was made 4 inches thick; but two channels were cut in the upper side to serve as flow-offs after the mold was filled and also to reduce the amount of metal to be cut off later in the machine shop.

On the following day the fire and ashes were cleared away from the mold, after which the two rings were placed in position and a couple of weights set on to keep them down. About 2000 pounds of *hot* iron were employed in this burning-on job. The ladle was manipulated so that a constant stream of iron followed the ring all around. On account of the two holes, the depth of molten iron in the mold never exceeded an inch and therefore the fresh, hot metal from the ladle was constantly brought into

intimate contact with the end of the casting. The end of a bent rod was employed to *feel* the end of the casting from time to time and when it was found that complete fusion had taken place the two holes were plugged. The mold then was filled to the top and a small amount allowed to flow off.

After the mold had set and there was no longer any danger of breaking the flange the brick work was loosened to permit contraction. It was then covered with sand and allowed to cool slowly. On the following day it was taken out of the sand, chipped and cleaned and sent into the machine shop. Here the new flange was finished and it turned out to be good and solid and well knit to the casting, in fact as good as if it had been cast on.

Finishing Metallurgical Specimens

BY J. F. ADAMS

OWING to the ever-increasing interest taken in the microscopic study of etched sections of metal alloys, together with the necessity of securing smooth surfaces for testing metal hardness, more attention is being focussed on rapid methods of preparing such surfaces. Metallurgical laboratories now handle so many specimens that the problem of speeding up their preparation has become a serious one. Before going into the operations involved, it is well to settle one point, the distinction between abrasives and polishing materials in the strictest sense of the word. Abrasives are grinding materials which act as individual cutting tools to remove a cylindrical parabolic chip (in some cases conchoidal) because of the fact that they are harder than the surface upon which work is being done. Under the microscope, the surface shows many furrows running in the same general direction. However fine the abrasive used, furrows are always cut. Surfaces produced in this way will acquire a polished appearance, but are not suitable for fine microscopical work in the study of metals or crystal structures in general because the magnified surface reveals imperfections. In the case of polishing, the materials used are usually softer than the work. Furrows from the previous abrasive operation are gradually closed or bridged over by the surface flow caused by rubbing of the polishing material. All substances are plastic to some extent responding to rubbing by movement of the surface skin. The process is analogous to the action of a mason with his trowel when he levels the mortar by sliding his tool across the plastic mess. This process greatly reduces the furrows but produces a "skin" not characteristic of the metal to be examined The depth of this skin depends upon how much care has been exercised in polishing. The use of too coarse abrasives, too much pressure, or hasty manipulation of the polishing materials will cause actual deformation of the crystal masses to some depth. After careful work, etching will bring out the true metal structure but will not do so where deformation has taken place.

Among the natural abrasives in common use are flint and garnet for woodworking and emery for metals. Two artificial abrasives are standard, the fused crystalline aluminum oxide and synthetic silicon carbide. These two electric furnace abrasives possess evidently different characteristics though both are harder than 9 on the mineralogical scale. Manufacturers offer them under a variety of trade names, but they all represent one of these two chemical compounds.

SPECIMENS ARE GROUND LEVEL ON A BELT SANDER

Under the heading of polishing materials come the unfused oxides of aluminum, magnesium, iron, and chromium. French chalk is also used to some extent. The most commonly used is rouge which is fine ferric oxide, though the most satisfactory material for fine finishes is probably aluminum oxide, made by fusing aluminum alum and levigating.

To prepare metal specimens for examination a piece is first cut by hand or with a power hack saw about ¼ inch thick by ½ inch square. In cases where sawing is not practicable, it will be necessary to break off a chunk with a hammer. The broad faces must be as nearly parallel as possible. The next operation involves grinding with aluminum oxide abrasive cloth for high tensile strength metals and silicon carbide cloth for soft metals, using either a grinding belt or disk. The former is preferable, since the furrows are straight and all parts of the abrasive surface move at the same rate of speed. Endless belts and disks can be bought all made up. It does not pay to attempt to coat them in the laboratory. Since the metal usually bears a tough outer scale, the first rough grinding operation may be done with grades as coarse as No. 1 (80 mesh) followed by No. 0 (120 mesh) and No. 3/0 (166 mesh). It may not be necessary to use all three grits and it may be possible to start with coarser or finer grades than the foregoing. Only experience will tell. After each grinding the specimen should be rotated 90 degrees so that the next set of furrows will be perpendicular to the previous ones. In each successive operation, the size of the furrows decreases. During grinding the piece must be held flat, to avoid rounding the edges. If

only difficulty is experienced, rounding the edges, a simple clamp can be devised, or in the case of mineralogical specimens the piece may be set in plaster of paris. The next operations are effected on emery polishing paper in grits from No. 0, the coarest, to No. 4/0, the finest. The paper is made in this country by several manufacturers. The sheets are usually cemented or clamped to a disk grinder head. The specimen is applied to the disk by hand and is slowly moved across its face, the disk traveling at about 1200 revolutions per minute.

Must Avoid Scratches

The piece is now ready for polishing. A felt cloth is fastened to the disk plate or to a stationary block (for hand work) and moistened with suspended alumina or other polishing agent. A choice of several grades of fineness is to be had, rated according to the length of time the particles will remain in suspension. The test piece is applied to this wet felt. The felt should not be allowed to dry out If the polishing material tends to cake more water should be used. If working by hand the piece is moved back and forth over the felt in a direction perpendicular to the old furrow lines. Only a fine texture felt can be used. Coarse threads or ridges will cause scratching. All of the foregoing materials can be obtained from supply houses and it is well to go to such houses rather than resort to home-made expedients. A few precautions should be added at this point, which apply mainly to the use of abrasives but also in some measure to the polishing operation.

1.—Do not allow the specimen to overheat. This causes changes in the temper and consequently in the structure.

2.—Do not press too hard in the effort to hasten results. Pressure tears and deforms the surface, causing permanent deformations of considerable depth.

Burnishing is simply an exaggerated case of surface flow or deformation. It can be produced in this way and often misleads beginners because of the lustrous finish which may be produced.

In the directions given above, treatment has been outlined for the preparation of specimens for etching. The same principles apply in preparing them for other purposes, although it is not always necessary to carry the process so far nor to use so much care A few of the uses for which such test pieces are prepared are as follows:

1.—For etching preparatory to microscopic examination to determine structure.

2.—For tests dependent on resistance to scratching or cutting. These are commonly performed by the Turner or Martin sclerometer or the Jagger microsclerometer.

3.—For tests dependent on resistance to indentation where stressed beyond the elastic limit. The Brinell tester illustrates this class.

4.—For tests dependent on the elastic reaction of the test piece, usually performed by the Shore scleroscope.

5.—For the last two classes very little preparatory work is required and all or most of that can be performed on the belt or disk at a high rate of speed. In the case of rolled sheet grinding it is usually unnecessary.

The accompanying illustration shows a small surfacing machine, equipped with an endless belt and a vertical disk, designed to do this type of work. Belt speeds range around 2500 feet per minute and grinding disk or wheel about 1200 revolutions per minue. Belts and disks can be obtained from any manufacturer of coated abrasives. In the case of belts it is most essential to obtain those with smooth running joints that will flow rather than bump. Having obtained a machine for the purposes outlined, additional uses are bound to crop up to make it more than ever a factor in the speeding-up process. Glass tubing and glassware may be tapered, burred, or beveled, corks tapered or reduced in diameter, knives sharpened, articles of wood, hard rubber, or composition rapidly shaped with a machine of this type. Thus it is seen that a machine of this type can be used for a variety of purposes not originally contemplated.

An Emergency Pattern for a Pulley

BY M. E. DUGGAN

INTERESTING and instructive articles appear from time to time in the various technical journals on the subject of making wheels and pulley patterns. In nearly every instance rules are given governing the design and how the pattern should be made. This information is of value and should be known by every patternmaker but his education should not stop there. Instances occur every day where a cheap hastily made pattern is wanted on a break-down job and the man who has simply learned to make patterns according to the rules based on theoretical methods will find himself seriously handicapped. Furthermore, the time, labor and expense wasted on a job of that character is a factor which must be reckoned when it is realized that by ditching all the rules and employing ordinary common sense a perfectly satisfactory pattern could have been turned out in a minimum of time. A recent incident illustrates this point.

A young journeyman patternmaker with the regular artistic temperament was called upon to make a pattern for a machine-cut gear wheel according to the dimensions shown in the accompanying illustration. He was supplied with a blueprint drawn in accordance with all the rules and regulations covering that class of work, but the foreman told him to neglect the nonessential points and get a workable pattern out in the shortest possible time.

The Orthodox Way

The young man only knew one method for constructing wheel patterns and proceeded to lay out his job in the orthodox way. The only available wood turning lathe in the shop had a 20-inch swing and a *blind* outer end. To turn a 24¾ inch built-up wheel on this lathe he decided that it would be necessary to raise the head stock about 6 inches. He raised the head and was cutting a piece out of the belt when the foreman, who had been on a visit to the foundry, returned and sized up the situation.

The pattern was wanted in a hurry and he had no time just then for explanations, experiments, or chances for mistakes, so he handed the job over to an old journeyman patternmaker who knew from experience just how far he could go in the construction of a cheap and hastily made pattern and still have one that would answer the purpose.

The blueprint called for oval and tapering arms, rounded corners and filleted angles. These details were ignored and the pattern made according to the design shown in the illustration. Instead of making arms the center was formed as a web with six 4-inch holes through it as indicated in Fig. 1. It may be noted from the side elevation shown in Fig. 2 that six courses of segments were employed, and it also may be seen by referring

to Fig. 1 that six segements made up each course. The ring forming half of the rim is shown in Fig. 3.

The only hand work on this pattern was in jointing the ends of the segments. The stock for the web, the rim and the hub was dressed on the planer to the required thickness, that is, the stock for the web was dressed to 1 inch and that for the rim dressed to ⅞ inch. Three thicknesses of rim segments formed one-half of the rim.

In usual pattern making practice the holes in the web would be cut out of the solid board with a keyhole saw. In this case the patternmaker cut tapered and finished the holes on the band saw. He ran a saw cut through the web at *D. E. F. G, H* and *I.* before attaching the segments for forming the rim.

The templet for the segments was laid out with extreme accuracy and cut to the line, not *through* the line. A number of pieces, each one long enough to make the segments, were cut off the ⅞-inch plank. These were stacked 6 high and fastened together. The templet was laid on the top board and the outline of the segments traced, after which they were cut out on the band saw. About ¼-inch stock was allowed on the sides of the segments for the finish sawing.

Nice Band Saw Work

Each of the rings forming the rim was made as follows: The first course was made with the segment *C* loose; the second course was built on with the joint *A* left loose; the third course was built on with the segment *B* loose. The band saw was passed through the joint *A* after which the segments *B* and *C* were returned to their places. The saw table was then tipped to the required angle to furnish draft on the pattern and the inside of the ring cut to size and finish. To do this sawing job correctly so as to leave the surface free from humps and ridges it must be done steadily and not by *fits and starts.*

After the inside sawing was finished the segments *B* and *C* were removed and the saw withdrawn through the slot at *A.* The segments and ends at *A,* on both sides of the web, were given a coat of glue, put back in place and secured with nails in position on the web. A circle conforming to the outside circumference of the required wheel was then described on the top edge of the pattern after which the band saw was slightly tilted the opposite way and the outside of the pattern sawed to the required diameter.

Another point that will be noted in the construction of this job is that the pattern was not split in the center to be molded one half in the cope and one half in the drag. It was made solid with the parting of the mold at the top face of the ring and with the idea of molding the entire pattern in the drag. The hub on the drag side was fastened to the pattern, but the hub on the cope side was left loose to assist the molder in securing a *lift.*

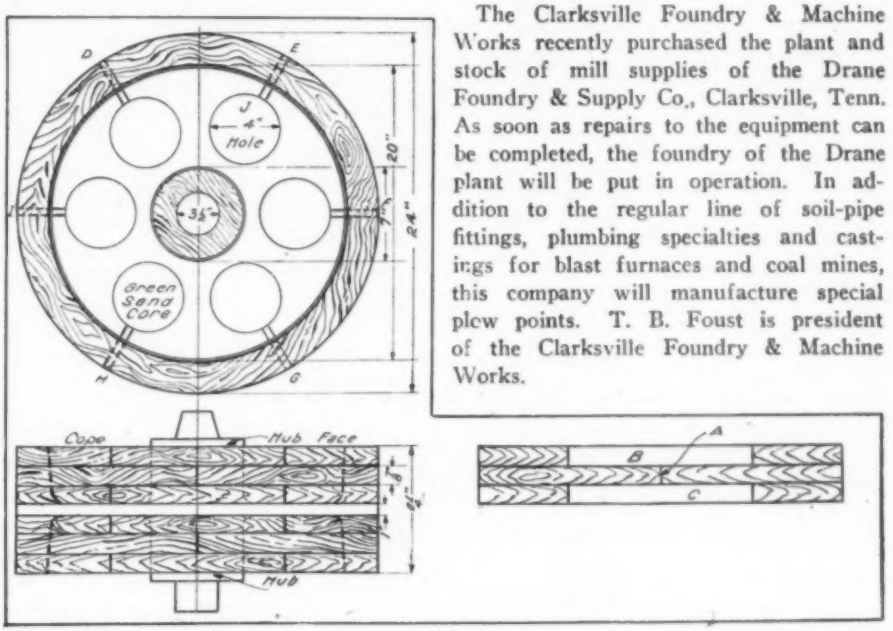


FIG. 1—PLAN VIEW OF PULLEY FIG. 2—SIDE VIEW SHOWING LOCATION OF THE SEGMENTS FOR THE WEB AND RIM FIG. 3—THE ASSEMBLED RING SHOWING THE OPEN JOINT *A* AND THE SEGMENTS *B* AND *C* REMOVED

This pattern was made with a minimum expenditure of time and labor and for all practical purposes was as satisfactory as one made in the orthodox manner.

Increases Capitalization

Lumen Bearing Co., Buffalo, at a recent stockholders' meeting increased its capitalization from $200,000 to $500,000, of which $100,000 is to be distributed to the present stockholders as a stock dividend of 50 per cent. The remainder of the new issue will be used for extensions. The company operates plants at Buffalo and at Youngstown, O. William H. Barr is president, C. H. Bierbaum vice president, N. K. B. Hatch secretary, and H. P. Parrock general manager. Kester Barr is manager of the Youngstown plant.

Will Remove Only Executive Department

The Crucible Steel Co. of America contemplates moving of some of its executive departments from Pittsburgh to New York on April 1. This move will comprise the president's and treasurer's offices as well as the accounting department. The offices now in the Empire building, Pittsburgh, will be concentrated with those which will remain in the Oliver building. The report in circulation that the company's entire business would be removed to New York is erroneous.

Purchases Foundry

The Clarksville Foundry & Machine Works recently purchased the plant and stock of mill supplies of the Drane Foundry & Supply Co., Clarksville, Tenn. As soon as repairs to the equipment can be completed, the foundry of the Drane plant will be put in operation. In addition to the regular line of soil-pipe fittings, plumbing specialties and castings for blast furnaces and coal mines, this company will manufacture special plow points. T. B. Foust is president of the Clarksville Foundry & Machine Works.

Power House Now Foundry

The Fremont Casting Co., a subsidiary of the Curtis & Marble Machine Co., Worcester, Mass., has begun to pour iron in its foundry, formerly a power house of the Worcester Consolidated Street Railway. The cupola will produce a larger output of castings than the parent company will require, so the excess capacity will be devoted to a jobbing business. Herbert A. Davis, formerly of the foundry department of the Crompton & Knowles Loom Works and later with the Hendey Machine Co., Torrington, Conn., is superintendent, and Henry A. Wilbur is office manager.

Addresses Steel Treating Society

"The Function of Insulation and Its Application to Heat Treating Furnaces" is the title of an address presented by E. F. Davis of the Celite Products Co., New York, before the New York chapter of the American Society for Steel Treating, at its monthly meeting, Jan. 19, at the Machinery Club, 50 Church street, New York city.

The Societa' Anonima Elettrica Ghise F. Acciai, Genoa, Italy, is constructing an extensive foundry and requests catalogs of supplies and equipment.

THE FOUNDRY

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Contents

	Page
Electricity Shop's Sole Heat Source	87
University Conducts Engineering Research	91
Chicago Foundrymen's Club Elects Officers	91
Shows Trends in German Practice	92
Forms Alloy Research Association	93
Molding a Large Planer Machine Bed	94
Sand Plays Part in Poor Castings	95
Inventor Installs His Own Devices	98
Analyze Loss in Aluminum Shops—IV	104
How and Why in Brass Founding	111
Bearings Cast too Cold	111
Cannot Melt High Zinc Alloys in Cupola	112
Difficulties with Pump Plunger Cores	112
Alloy to Resist Moisture	112
Babbittless Bearing	112
Brass for Conductors	112
Bill Melts Some Heavy Scrap	113
Making a Pair of Composition Mounts	115
Burning a Flange Upon a 16-Inch Elbow	116
Finishing Metallurgical Specimens	117
An Emergency Pattern for a Pulley	118
Increases Capitalization	119
Will Remove Executive Department	119
Purchases Foundry	119
Power House Now Foundry	119
Technical Press as an Educator	120
Trade Outlook in the Foundry Industry	121
Comings and Goings of Foundrymen	122
Motor-Driven Portable Disk Sander	123
Re-elects Officers	124
Discusses Foundry Practice	124
Look for More Activity	123
New England Foundrymen Hold Annual Meeting	123
Changes Name and Makes Capital Increase	123
Price Reductions Portend Revival	124
What the Foundries Are Doing	125
New Trade Publications	126

Technical Press as an Educator

THE late Thomas D. West who in his time probably did as much as any other one man to advance the science and art of making castings, points out in his book *American Foundry Practice* that the man who aspires to become a master foundryman has a long and difficult road before him. After serving four years as an apprentice molder the seeker after knowledge is advised to spend at least six years in different shops to round out his grasp on the trade. In the meantime, he is told to spend his spare time in studying all the available literature on the subject. Not only literature pertaining to molding practice, but that relating to melting and mixing metals and also anything touching on the financial and executive problems connected with the business, are recommended. The modern aspirant for an executive foundry position, or the student of foundry problems who seeks a comprehensive knowledge of the subject has a much wider field to cover than either his father or his grandfather. Even if he takes up but one branch of the business, he will find that owing to its innumerable ramifications he can pursue it profitably for the remainder of his natural life without exhausting the subject.

The period spent in traveling from shop to shop, although still of considerable educational value may be omitted. This is partly because shop secrets no longer are guarded so jealously. Furthermore, foundry practice, at least in similar lines is now fairly well standardized. The main factor which obviates the necessity for a traveling apprenticeship is the wide circulation of the technical press which in recent years has made it possible for a man to become familiar with every method, every process and every new development of the industry, not only in his own country, but abroad, without neglecting his other duties or without leaving home.

Technical knowledge usually is disseminated through one of three recognized methods; the spoken word, the example and the printed page. Generally the comparative effectiveness of these three methods may be reckoned in the same relative order. For specific cases, the first or second; or possibly a combination of the two is the most satisfactory; but as a means of doing the greatest good to the greatest number, the printed page in this age of wide circulation occupies the premier position.

At the utmost, the benefit derived from the spoken word or from a demonstration given by the author of a new method or the discoverer of a new process is limited to a comparatively small number of interested students. If repeated often enough and before a different group each time, the subject eventually becomes familiar to all those engaged in an industry. Such a method of disseminating information, of course, is neither adequate nor practical.

Articles in the technical press fill the gap between the formal lecture and the elaborate text book on each specialized subject relating to the industry. The technical periodical is published at sufficiently frequent intervals to keep abreast of the industry it serves and also to hold the sustained interest of the reader. It is an open forum in which the leading minds in the industry are accustomed to air their opinions and it serves as a chronicle to note the changes and improvements made from time to time

Trade Outlook in the Foundry Industry

JANUARY has shown signs of reawakening interest on the part of buyers, but not to a degree which would warrant an early return to full time production on the part of all manufacturers. It has been estimated that the normal replacement requirements of the country would occupy fully 80 per cent of the existing productive capacity of essential industries. In other words, when only those commodities are purchased which will suffice to feed, shelter, and cloth the entire country, counting the transportation, and other contributing agencies, industry would be engaged to 80 per cent of its normal ability to produce.

Foundry Recovery Slow

Castings manufacturers were among the last to feel the full impact of the present depression. The nature of the commodities produced in foundries fundamentally is secondary, although basic to a marked degree and essential to practically every line of human activity. Those manufacturers who are large users of castings, in many instances stopped production in their plants coincident with or preceding the time when they cancelled their castings orders. For this reason, in the greater number of instances, stocks of castings are available to support the part time operation which marks the resumption of activity in many lines. The past week or ten days have given evidence that the low point in the slump has been approached. Previous to this time, every day has brought forth new reports of plants which have suspended. No section of the country was free from this, and only a few plants reported that they again would resume operations soon. Recently a change has taken place. Mills and factories again are starting their plants or are increasing the rate of operation throughout the country.

Building Expected

Manufacturers supplying the building trades are commencing to stock for spring business, which is expected to be accellerated when the construction season opens. In the East this prospect has resulted in the resumption of activity among valve, plumbing goods and fire extinguisher manufacturers. In the South, early February is expected to mark the resumption of large scale operations in the pipe plants which for the time have been severely affected by reluctant demand. Soil pipe and fittings foundries are expected to share in the revival which is anticipated. Stove works in the South again are operating on part time schedule. The current demand is largely from the cities and towns, as the agricultural sections have been hard hit by losses due to falling crop prices. In other parts of the country, the stove and furnace shops are little affected. Through New England, better conditions are at hand. The leather and shoe trades again are in operation, bringing a strengthening influence upon the demand for machinery, while machine tool manufacturers with their contributing foundries have begun work under a limited schedule. In Vermont, a large number of smaller plants had some orders on hand throughout the period of stagnation, but not enough of them to warrant operating. Most of these foundries now are running part time. Cream separator, and syrup making equipment manufacture which furnishes a steady demand for jobbing castings has dropped away, but indications point to better business during the next month or six weeks.

Operations Vary

A few foundries, even though they are not operating, are taking steps to cover on their pig iron requirements against expected activity. The agricultural implement trade still is slack, but foundries contrbuting to this branch of industry are more active than generally is supposed. Jobbing foundries are working part time. Although the automobile industry, which provides a tremendous demand for castings in Ohio, Indiana, Illinois Michigan and Wisconsin, has been practically at a standstill for two months, an early resumption is hoped for. The replacement demand is expected to provide requirements that will uphold moderate operation throughout the year. Over 8,500,000 cars now are registered in the United States, and the replacement demand, it is said, will supply a steady sale during the coming year. The National Automobile Chamber of Commerce gives the total output for 1920 as 2,241,000 cars, excelling the previous high mark of 1,974,016 cars produced in 1920. Export trade in automobiles has shown a slight improvement as is evidenced by a total of 180,000 cars sent abroad to 114 countries in 1920.

Stocks Are Handicap

Those plants which were caught with a large stock or contracts for heavy deliveries of high priced iron and coke are finding it difficult to meet the competition of those which were more fortunately placed. One mallebale foundry bidding on a large order of malleable hubs for automobile wheels was underbid 4 cents on the pound by another firm which did not have the handicaps mentioned. Brass foundries are slack. Prices on nonferrous metals, based on New York Quotations of Jan. 25 follow: Casting copper, 12.50c; lead, 5.00c to 5.30c; Straits tin, 32.00c to 33.00c; antimony, 5.30c to 5.40c; aluminum, No. 12 alloy, producer's price, 27.30c and open market, 20.00c to 22.00c. inc is .35c, E. St. Louis, Ill.

Prices of Raw Materials for Foundry Use

CORRECTED TO JAN. 25

Iron		Scrap	
No. 2 Foundry, Valley	$30.00	Heavy melting steel, Valley	$15.00 to 15.50
No. 2 Southern, Birmingham	30.00 to 33.00	Heavy melting steel, Pittsburgh	15.00 to 16.00
No. 2 Foundry, Chicago	31.00	Heavy melting steel, Chicago	15.50 to 16.50
No. 2 Foundry, Philadelphia	32.50 to 34.50	Stove plate, Chicago	21.50 to 22.00
Basic, Valley	29.00	No. 1 cast, Chicago	21.00 to 21.50
Malleable, Chicago	32.50 to 35.50	No. 1 cast, Philadelphia	24.00 to 25.00
Malleable, Buffalo	32.50	No. 1 cast, Birmingham	21.00 to 23.00
Coke		Car wheels, iron, Pittsburgh	21.00 to 22.00
Connellsville foundry coke	$6.50 to 7.00	Car wheels, iron, Chicago	21.50 to 22.00
Wise county foundry coke	9.50 to 10.00	Railroad malleable, Chicago	17.50 to 18.00
		Agricultural malleable, Chicago	17.50 to 18.00

Comings and Goings of Foundrymen

CLIFFORD S. LOVELL, superintendent of foundry departments of the Walker Pratt Mfg. Co., Boston, was elected president of the New England Foundrymen's association for the year 1921 at the regular annual meeting held Jan. 12. Mr. Lovell comes from a long line of foundrymen, dating back almost to the start of this industry in New England. His grandfather, J. B. LeBaron, built a foundry at Middleboro, Mass., in 1857, and it was here that Mr. Lovell at the age of 17 first was employed as a molder. At the age of 26 he was put in charge of this foundry which at that time had 35 molders. At 30 he left Middleboro to take charge of the Vulcan Foundry at Pawtucket, R. I., which since has been discontinued. Here he remained until the year 1900, when he became associated with E. H. Mumford, of Philadelphia, first with the sales department of the Tabor Mfg. Co. and later with the E. H. Mumford Co. In 1909 he entered the organization of Baxter D. Whitney & Sons, wood working machinery, Winchendon, Mass., as superintendent of the foundry, where he stayed two years, leaving to accept his present position. The foundries of the Walker Pratt Co. employ approximately 115 molders and recent extensions have increased the capacity so that 155 molders could work advantageously if necessary. Mr. Lovell long has been an enthusiastic member of the New England Foundrymen's association and during the past year has been responsible for many of its interesting meetings.

John Blume has affiliated with the Vulcan Iron Works Co., Denver, as foundry superintendent.

L. A. Larsen, secretary and treasurer of the Lima Locomotive Works, Lima, O., has been elected vice president in charge of finance and accounting.

E. Lea Marsh, president, Bay View Foundry Co., Sandusky, O., recently has been elected secretary of the United States Gypsum Co., Chicago.

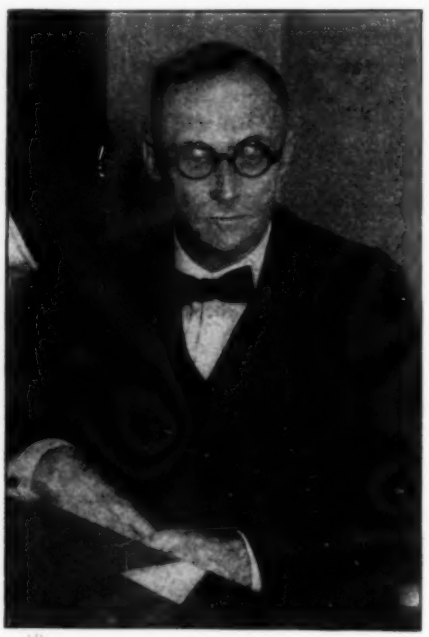
F. E. Holcomb, president of the Williams Foundry & Machine Co., Akron, O., has been re-elected, together with S. F. Zilliox, vice president; G. C. Dietz, treasurer; and W. J. Slater, secretary and treasurer.

Hugh R. Corse recently has been appointed sales engineer for the Lumen Bearing Co., Buffalo. Mr. Corse formerly was connected with the Titanium Bronze Co., Buffalo.

D. O. Thomas has been appointed plant manager of the Saginaw Malleable Iron Co., Saginaw, Mich., which is part of the Saginaw Products Co., a division of the General Motors Corp.

I. H Billiar, works engineer of the Duquesne Steel Foundry Co., Duquesne, Pa., has resigned to become assistant engineer of the Mayville, Wis., plant of the Steel & Tube Co. of America.

Frank C. Miller, formerly representative of the foundry department of



CLIFFORD S. LOVELL

the Otis Steel Co., Cleveland, in Detroit territory, now is Detroit district representative of the Brier Hill Steel Co.

L. W. Skinner has been appointed foundry foreman of the Mutual Iron Works, Lakeland, Fla. Previously Mr. Skinner was foundry foreman for the Maddox Foundry & Machine Co., Archer, Fla.

Thomas S. Downing, for several years associated with operating departments of various Pittsburgh and Philadelphia steel plants, has been placed in charge of the Pittsburgh office of Briggs & Turivas, Chicago, at 975 Union Arcade building.

M. L. Northrop has been appointed New England representative of the Warren Foundry & Machine Co., Phillipsburg, N. J., succeeding H. H. Kimsey, who died recently. Mr. Northrop will have offices at 201 Devonshire street, Boston.

A. E. Nelson of the National Cast Iron Pipe Co. has been put in charge of sales of the Somerville Iron Works, Somerville, N. J. manufacturer of sanitary pipe and fittings in Middle West territory with headquarters at 903 Commercial Trust Co. building, Kansas City.

Carl Oehler, Mesta Machine Co., Pittsburgh, delivered an interesting address on "The Essential Features of the Electric Furnace and Its Future in Iron and Steel Production," at a monthly meeting of the Pittsburgh chapter, American Society for Steel Treating.

F. R. Edmunds, formerly assistant superintendent of the Dayton Malleable Iron Co., Dayton, O., has been elected president of the Kittanning Foundry Co., 1002 Empire building, Pittsburgh, which recently was organized. James W. King is secretary and treasurer of the new company.

J. G. Melbrod who has had a wide experience in the casting of titanium, aluminum and other bronzes has been placed in charge of the foundry operated by the Hills-McCanna Co., 2025 Elston avenue, Chicago. This company make a specialty of bronze worm wheels, high conductivity copper and manganese aluminum castings. Mr. Melbrod during the past four years was foreman of the foundry of the Titanium Bronze Co., Niagara Falls, N. Y., and prior to that connection he was affiliated with the Lumen Bearing Co., Buffalo.

E. V. Brown recently has been appointed Chicago manager for the Hill & Griffith Co., Cincinnati, manufacturer of foundry facing, equipment and foundry supplies. Mr. Brown, who was graduated from the Culver military academy in 1901, entered the drafting department of the Whiting Foundry Equipment Co., now the Whiting Corp., Harvey, Ill. Later he was designing engineer for this company and retained that position until 1910, when he became a designer for the Municipal Engineering & Contracting Co. In 1912 he re-entered the employ of the Whiting Foundry Equipment Co., as designing engineer, and remained with that company until his recent affiliation with Hill & Griffith.

Motor-Driven Portable Disk Sander

The disk sander shown in the accompanying illustration, made by the Syracuse Sander Mfg. Co., Inc., Syracuse, N. Y., is motor-driven, portable, easily moved about and may be operated from any lamp socket or power circuit This machine is said to be especially adapted for pattern shops or for any woodworking shop and also is a handy machine for a machine shop handling light work. It is claimed that it is a wonderful time saver for grinding small metal parts especially brass and aluminum. Garnet paper discs are used for wood work and Alozite or emery cloth discs for metal work.

The annoyance and inconvenience of dust incidental to operation of machines of this character is overcome by an ingenious vacuum system which collects at least 90 per cent of the dust. The dust is carried through the post of the pedestal to the floor.

The table may be tilted by a hand adjustment to 45 degrees below the horizontal and 15 degrees above. A turn of the two small handles holds the table at the desired position. This feature together with an angle gage graduated in degrees and a gage for grinding core prints assists accuracy and speed of operation. The motor is totally enclosed. It is built especially for the machine and runs on ball bearings.

Re-elects Officers

The Philadelphia Foundrymen's association recently re-elected the following officers: President, Thomas Devlin, the Thomas Devlin Mfg. Co.; vice president, George C. Davies, Pilling & Co.; secretary, Howard Evans, J. W. Paxson Co. W. G. Summers, Phoenix Iron Co., Philadelphia and Phoenixville, Pa., has been elected treasurer to succeed Josiah Thompson. Mr. Summers in addition to being treasurer, succeeds Mr. Thompson as a trustee of the association. Frank Hodson, Electric Furnace Construction Co., has been elected a member of the executive committee to succeed the late Horace L. Haldeman.

Discusses Foundry Practice

Some interesting sidelights on present day business conditions from the banker's standpoint were given by A. D. Sallee, credit manager of the Farmer's Deposit National bank, Pittsburgh, at the regular monthly meeting of the Pittsburgh Foundrymen's association held Jan. 17 at the Chatham hotel. He stated that in his opinion the automobile manufacturers would recuperate at an early date and be a strong factor in the prosperity of the country for some time to come. About 75 members were present and listened with interest to Stephen L. Goodale, professor of metallurgy at the University of Pittsburgh, who discussed foundry practice from a historical standpoint.

Look for More Activity

That 1921 will be a good year in the foundry equipment field was the consensus of opinion at the annual convention of the sales, service and

THIS SANDER MAY BE MOVED FROM PLACE TO PLACE AND SET UP ANYWHERE

manufacturing departments of the American Foundry Equipment Co., held in Chicago, Jan. 6, 7 and 8. In numerous cases conditions exist which are holding up programs for extensions and improvements at various foundries and as soon as these are removed, officials and representatives of the company believe, considerable new business will result.

Verne E. Minich, president of the American Foundry Equipment Co., authorized the immediate execution of plans, suggested at the convention, whereby certain improvements will be applied to sand cutting and sand blast equipment manufactured by this company. Mr. Minich also outlined methods by which the service department of the company will supplement the sales department in making its equipment of maximum usefulness to foundrymen. Especial attention was paid at the convention to developing plans for marketing the company's new molding machines of the electrically operated and gravity types; the latter type already has been applied extensively to the production of radiators and soil pipe.

James Rigby Jr., heretofore assistant general sales manager of the American Foundry Equipment Co., was promoted to the position of sales manager and will continue to make his headquarters at 366 Madison avenue, New York.

New England Foundrymen Hold Annual Meeting

The twenty-fifth annual meeting of the New England Foundrymen's Association was held at the Exchange club, Boston, Wednesday, January 12 with all the old-time enthusiasm and with an attendance of nearly 200 foundrymen from many points in Massachusetts, Maine, Connecticut and Rhode Island. This meeting, according to custom, was the occasion of the election of officers, the appointment of an executive committee and also of a banquet. The new officers are President, C. S. Lovell, of the Walker-Pratt Mfg. Co., Boston; vice president, E. H. Ballard, General Electric Co., Lynn, Mass.; treasurer, George H. Gibby, Gibby Foundry Co., East Boston, Mass., and secretary, Fred F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass. The new executive committee is headed by Charles A. Reed of Reed, Fears & Miller, Boston. The other members are George A. Ray, Taylor-Fenn Co., Hartford, Conn.; L. M. Sherwin, Brown & Sharpe Mfg. Co., Providence; Harry T. Welch, Milford Iron Foundry, Milford, Mass., and John Busch, Chapman Valve Co., Springfield, Mass.

Changes Name and Makes Capital Increase

The Whiting Foundry Equipment Co., Harvey, Ill., announces that it has changed its name to Whiting Corp., increasing its authorized capital stock from $700,000 to $3,000,000. The Whiting Corp. remains under the same management and will continue the manufacture of cranes, foundry equipment and railway specialties as heretofore.

The McMyler Interstate Foundry, Warren, O., recently has been taken over by the Eastern Ohio Mfg. Co. S. W. Hull has been appointed Cleveland representative.

Price Reductions Portend Revival

Manufacturers Lower Prices on Foundry Equipment and Establish New Level to Aid in Return to Stable Basis in Industry

ALTHOUGH the advances in foundry equipment prices by no means have equalled those in other lines of manufacture, generous reductions are being made and a new level of prices has been reached. These range from 5 to 33 1-3 per cent below the previous base, and cover principally cupolas, sand blast and handling machinery. Slight improvement has been noted by equipment builders in the character of inquiries. December marked a gain in sales in practically all the lines supplying foundries, and indications point to an even greater improvement in January, due to the normal first of the year repair and replacement demand. Plant extensions are not projected to a degree which would promise much in the next few months, but a number of new enterprises, notably smaller gray iron and brass shops are contemplated. Many of these are to be undertaken by executives of larger companies who look forward to greater opportunities.

Low Level Reached in East

PRICES on foundry equipment fast are becoming established at lower levels. Cupolas and sand blast machinery now are available at five and 10 per cent off, and on the general run of smaller equipment the concessions range as high as 20 per cent. Reductions also are noted in conveying equipment. Recently two large builders of locomotive cranes lowered their prices between 10 and 15 per cent, and it appears as if the market on this line of equipment is now close to 25 per cent under the high post-bellum price, established early in 1919, and possibly 30 per cent under the peak level recorded during the war. Overhead cranes, particularly electric cranes, have not declined materially. There have been some rather drastic reductions in a few particular cases, but on the whole, the market on this type of cranes has been relatively firm. It is estimated roughly that electric overhead cranes now average 20 cents a pound, as compares with 22 cents quoted until a period three months or so ago.

This higher figure, incidentally, represents the peak level of the market for the past two years and compares with the low level of 16 cents, established shortly after the armistice, and the high price of 25 cents reached during the war. Hoists, it is said, have declined of late approximately 10 per cent. Demand in the eastern foundry equipment market continues of restricted proportions. There are a few sizable propositions being figured upon, but business generally has not begun to open up. In fact, at the moment many of the foundries in this district—practically all—are operating on a greatly reduced schedule. H. Leon Brittain of New York, formerly of Birmingham, who with his associates recently incorporated the International Steel & Motors Co. with a capitalization of $10,000,000, is said to contemplate the erection of a steel foundry and motor parts plant near Rome, Ga. Sarachan & Rosenthal Co., Rochester, N. Y., and the Standard Underground Cable Co., Perth, Amboy, N. J., recently purchased electric melting units from the Detroit Electric Furnace Co., Detroit. The Sill Stove Works, Rochester, N. Y., recently purchased a new sand cutting machine from the American Foundry Equipment Co., New York, to replace one of the same make.

More Optimistic in Pittsburgh District

BECAUSE of some new inquiries which are coming out for foundry equipment and supplies, both makers and sellers note considerable improvement over the condition as it prevailed two weeks or a month ago. The Herman Pneumatic Machine Co. reports the receipt of several inquiries for molding machines and a few new orders. Several other orders for this type of equipment are promised. The Sterling Wheelbarrow Co. recently secured a sizable order for flasks. While demand for foundry cranes is low at present, a few inquiries are current at present for ladles and other similar equipment. The Windsor Foundry Corp., Windsor, Vt., which recently purchased a cupola and two tumbling barrels, now is looking for a 5-ton crane with a 35-foot span. It likewise is in the market for a 72-inch cupola complete with positive pressure blower. The A. Garrison Foundry Co., which entered the market for several foundry cranes a short time ago, still has this matter in abeyance and sellers eagerly are watching it, believing that the cranes soon will be needed and the inquiry revived. The Frick Co., Waynesboro, Pa., contemplates the erection of a new iron foundry, as its present plant is inadequate. The Homestead Valve & Mfg. Co., Homestead, Pa., recently purchased an electric furnace for melting gray iron from the Detroit Electric Furnace Co., Detroit. Pierce, Butler & Pierce Mfg. Co. recently have purchased a sand cutting machine from the American Foundry Equipment Co., New York.

Few New Projects in Chicago District

WHILE foundry operation in the Chicago district shows considerable signs of increased activity, as castings users begin to place further orders, the movement has not yet gone to a point where melters have come back anywhere near capacity. This condition is causing some buying of supplies in cases where not enough are on hand, but up to this time it has not gone to the length of bringing orders for much equipment. Frank D. Chase, Inc., a designer of foundries, practically has closed for a large malleable foundry to be built immediately in an eastern city. He also has plans under way for a stove foundry which is to be built at once, as indications are that the second quarter will find this industry rushed with business. Some revamping and additions are under way to increase capacity and steel foundries especially are looking forward to large business later. The George H. Smith Steel Castings Co., Milwaukee, is installing a 3-ton electric furnace to replace other melting agencies, and the American Manganese Steel Co. is about to install two 3-ton and one 6-ton heroult electric furnaces at its Chicago Heights plants. The W. W. Sly Co. has announced a reduction of approximately 33 1-3 per cent on all its equipment. The Detroit Copper & Brass Rolling Mills, Detroit, has purchased an electric furnace from the Detroit Electric Furnace Co. of that city. The Chicago Malleable Castings Co. is reported to contemplate the expenditure of about $50,000 in improving light and ventilation in its foundry and in the installation of six new annealing ovens. The Whiting Corp., Harvey, Ill., has reduced prices on its equipment 20 per cent during the past 30 days.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

The Moulds Brass Foundry, Benton Harbor, Mich., is building a new plant building.

The Pioneer Brass Works, Indianapolis, plans the erection of a plant building.

The National Malleable Castings Co., East St. Louis, Ill., plans plant additions.

The A. Garrison Foundry Co., Pittsburgh, has a permit to erect a plant building.

Robert Embers, Brooklyn, N. Y., plans the erection of a foundry, 60 x 100 feet, at 209 King street.

The Black Rock Foundry Corp., Buffalo, recently was incorporated with a capital stock of $50,000, by G. A. Gage, E. Hagmeir and G. Bork.

Fire in the pattern shop of the Griffin Wheel Co., Chelsea, Mass., recently caused a slight damage to the shop and equipment.

The Standard Chilled Castings Co., Lynchburgh, Va., has purchased a plant which it will remodel for its own use.

The brass foundry and the iron works of the Nekoosa Iron Works, Wisconsin Rapids, Wis., recently were damaged by fire.

The Reed Foundry & Machine Co., Kalamazoo, Mich., plans the erection of plant additions and new units.

The Keith Furnace Co., Des Moines, Iowa, is having plans drawn for the erection of a machine shop and foundry building.

The International Malleable Iron Co., Guelph, Ont., has purchased a site of 12 acres on which it plans additions to its present plant.

The Yale Piston Ring Co., Boonton, N. J., has been incorporated with a capital stock of $125,000, by F. S. Yale, T. C. Saxton and I. G. Yale.

Plans are reported being prepared by the Michigan Brass & Iron Works, Lansing, Mich., for the expansion of its plant.

The Miles Piston Ring Co., Chicago, is building a plant building, 98 x 161 feet, at 5345 South State street.

The Joliet Steel & Iron Co., Joliet, Ill., has awarded a contract for the erection of a foundry addition, 75 x 160 feet.

Capitalized at $250,000, the Brown Flint Range Co., Huntington, W. Va., has been incorporated by M. E. Brown, J. G. Miller and C. S. Porter.

Plans have been completed by the Baltimore Car & Foundry Co, Baltimore, for the erection of an addition to its plant.

The Globe Duluth Iron Works, Duluth, Minn., plans to remodel a building for a foundry and machine shop.

The Chester Iron & Foundry Co., 1800 Vulcan street, St. Louis, plans the erection of a foundry and power plant, 50 x 100 feet.

The Portsmouth Metal & Foundry Corp., Portsmouth, Va., will rebuild its plant which was recently damaged by fire.

Work has been started on the erection of a plant building for the Dayton Malleable Iron Works Co., Dayton, O.

Contract has been awarded by H. T. Potts & Co., Philadelphia, for the erection of a foundry building.

Work is expected to be started about April 1 on the erection of an administration building for the Marion Machine & Foundry Co., Marion, Ind.

The Wayland Specialties Mfg. Co., Wayland, N. Y., has had plans prepared for the erection of a plant, to include a foundry, 60 x 200 feet.

The Peoria Malleable Castings Co., Peoria, Ill., is doubling the output of its plant by the installation of an additional 25-ton furnace.

The Bergen Point Brass Foundry, 161 Hobart avenue, Bayonne, N. J., has been organized by A. W. Lindberg, 125 West Sixth street, and others.

Capitalized at $10,000 the Oxford Brass Foundry, Philadelphia, recently was incorporated by Nathan Glanzberg, Martin Stein and others.

The Fulton Foundry & Machine Co., Cleveland, has been purchased by a company headed by C. L. Bradley of the Union Commerce National bank, Cleveland.

The Meneely Brass & Bronze Co., Watervliet, N. Y., recently was incorporated with a capital stock of $10,000, by A. H., and H. Y. and E. A. Meneely.

The Taunton Casting Co., Taunton, Mass., recently was incorporated with a capital stock of $25,000, by Joseph P. McKenna, Wilbur E. Forbes and E. Owren, Attleboro, Mass.

The United States Hoffman Machinery Co., 715 West Fayette street, Syracuse, N. Y., has awarded a contract for the erection of a foundry building, 46 x 66 feet.

Capitalized at $5000, the Jacobs Aluminum & Brass Foundry Co., Lexington, O., recently was incorporated by S. L. Earhart, B. F. Jacobs, R. L. Swigert, E. M. Presser and M. Harbaugh.

The Super Valve Co., Springfield, O., recently was incorporated with a capital stock of $70,000, by W. E. Marshall, J. E. Kennedy, W. H. Bowers, W. A. Gillen and I. M. Enlitt.

Announcement has been made by interests at Gadsden, Ala, to the effect a company is now being organized which plans to erect a soil pipe manufacturing plant there.

The Canada Iron Foundries, St. Thomas, Ont., has within the past 12 months spent $150,000 on additions to its plant and now contemplates further extensions.

The Shea-Clancy Castings Co., Bridgeport, Conn., recently was incorporated with a capital stock of $50,000, by J. F. Shea, R. F. Clancy, K. Shea and C. Clancy.

Alexander Grant, New York, stoves, furnaces, etc., recently was incorporated with a capital stock of $5000, by J. Moses, W. and A. Grant, 19 Webster avenue.

The Commercial Brass & Bronze Foundry, San Francisco, has been incorporated with a capital stock of $50,000, by E. G. Doeth, C. F. V. Mehden and William Barker.

The Simons & Schmadeke Co., Brooklyn, N. Y., wood and metal patterns, recently was incorporated with a capital stock of $25,000, by G. S. Simons, J. F. and H. R. Schmadeke, 497 Union street.

Capitalized at $20,000, the Eastern Bronze Corp., New York, recently was incorporated by H. S. and W. Heichheimer and N. A. Jackolo, 1465 Broadway.

The Flood City Mfg. Co., Johnstown, Pa., manufacturer of brass and bronze products, is reported planning the erection of an addition to its plant, 80 x 200 feet.

Capitalized at $10,000, the Peabody Brass Works, New York, recently was incorporated by R. F. Kelley, G. B. Muller and C. Kessel, 150 Nassau street.

The T. R. Roberts Filter Mfg. Co., Philadelphia, has disposed of its plant to Basch & Co. It consists of a 2-story factory, foundry and power house and will be occupied by the new owner.

The Republic Furnace & Radiator Co., Maryland Casualty building, Baltimore, has been incorporated with a capital stock of $2,000,000, by E. McClure Rouzer, E. S. Stockbridge and others.

The C. E. Holt Mfg. Co., Indianapolis, has been organized with a capital stock of $100,000, by C. E. Holt, K. A. Holt and R. L. Holt, to engage in the manufacture of cultivators, etc.

The Woolsen Mfg. Co., Watertown, Conn., recently was incorporated to make brass goods, with a capital stock of $300,000, by Arthur F. Ellis, Waterbury, Conn., Carroll C. Hincks and William E. Thomas.

The Mack Furnace Co., Ltd., Chatham, Ont., has been incorporated to manufacture furnaces, stoves, etc., with a capital stock of $25,000, by E. M. Reeve, B. L. Bedford, Charles J. Cummings and others.

No plant extensions or the purchase of additional equipment are planned at this time by the Iron City Foundry Co., Hamilton, O., which recently increased its capital stock, according to advices from A. D. Stuckey, president.

A new foundry building will be built by the C. & A. Potts Co., Indianapolis, at Washington avenue and Blake street, that city. Work is expected to be started on the structure about Feb. 15. The company manufactures clayworking machinery and castings.

The Landall Farm Tractor Mfg. Co., Carey, O., has been incorporated with a capital stock of $500,000 and is reported planning to build a plant. It has taken over the assets of the Landall Tractor Co., of Toledo, O. O. I. Huston is president of the company.

No significance should be attached to the recent increase in capital stock made by the Chicago Malleable Castings Co., Chicago, as no improvements, other than equalizing the departments so that they will be large enough to take care of the production of other departments, according to an announcement by the company.

The Smith's Falls Malleable Castings, Ltd., Smith's Falls, Ont., has been incorporated to carry on a general foundry and machine shop business and the manufacture of iron, steel and other metalwork, etc. The company will take over the plant and business of the Smith's Falls Malleable Castings Co., Ltd. It is capitalized at $750,000, and was incorporated by Norman S. Caldwell, N. B. McPherson and others, of Toronto, Ont.

Iron is now being poured in the new foundry of the Fremont Casting Co., Worcester, Mass., a subsidiary of the Curtis & Marble Machine Co. The foundry was remodeled from a building operated as a power house by the Worcester Consolidated Street railway. The cupola has a capacity of 10 tons. Herbert A. Davis, formerly of the Crompton & Knowles Loom Works and the Hendey Machine Co., Torrington, Conn., is superintendent of the plant and Harry A. Wilbur, office manager.

The Rochester Castings Corp., Rochester, N. Y., which is capitalized at $2,000,000, recently awarded contracts for the erection of four units of its proposed plant at Buffalo and Field streets. The company recently bought the site, which consists of 40 acres, at a cost of $85,000. Work is expected to be started on the construction in a few days and it is expected the structures will be built at an estimated cost of $350,000. The main foundry building will be 200 x 400 feet, with bays capable of 1200-foot extension; the cleaning room and pattern shop building will be 120 x 400 feet with provisions for enlargement; the office building will be two stories, and a power plant will be 50 x 80 feet. The foundry will be equipped with three cupolas with a total hourly capacity of 40 tons. It is expected the plant will be ready for occupation about July 1. Officers of the company are President, Charles F. Wray; vice president, Albert N. Wright; secretary, Loren O. Graves, and treasurer, George S. Benedict. Gray iron castings will be manufactured.

New Trade Publications

RAIL WELDING—The Metal & Thermit Corp., New York, is circulating an illustrated booklet in which data pertaining to rail welding by the thermit process is described and illustrated.

INDUSTRIAL TRUCK—The Cowan Truck Co., Holyoke, Mass., has published a 32-page booklet in which industrial hand drawn trucks, are illustrated. The illustrations shown, are of trucks shown in use in a great variety of industries. Specifications are given in full.

BALANCING EQUIPMENT—A 26-page illustrated booklet has been published by the Norton Co., Worcester, Mass., in which balancing equipment for grinding wheels, is described and illustrated. The booklet contains directions for the use of the equipment, specifications and other data.

HOISTS—The Wright Mfg. Co., Lisbon, O., recently issued an attractive catalog, in which it describes and illustrates its line of products. Much new data on hoists, are given, and a portion of the booklet is devoted to a discussion of the various types of hoists and the field of usefulness of each.

JACKS—The Duff Mfg. Co., Pittsburgh, is circulating a new 148-page illustrated booklet in which it describes and illustrates its complete line of lifting jacks. These jacks are for all purposes, railway, automotive and industrial, and range in size from 1 to 75 tons lifting capacity.

FLOODLIGHT PROJECTORS—The Crouse-Hinds Co., Syracuse, N. Y., is circulating a 16-page illustrated booklet in which the use of floodlighting for industrial purposes, particularly for railroads and steel plants, is described. For these purposes a new type projector has been designed, and this is fully described in the booklet. Specifications and other data are given.

FOUNDRY EQUIPMENT—The C. O. Bartlett & Snow Co., Cleveland, is circulating a 16-page illustrated booklet in which various foundry equipment is described and illustrated. This equipment includes, overhead sand conveying apparatus, sand screens and core conveying equipment. The illustrations shown are of actual installations.

CONTROL APPARATUS—The Cutler-Hammer Mfg. Co., Milwaukee, is circulating a 40-page illustrated booklet in which motor control apparatus for pumps, compressors and similar service, is described and illustrated. The illustrations show actual installations of this apparatus, and the descriptions are of such a nature as to make it easy for those interested in selecting such equipment.

FIRE PROTECTION—Grinnell Co., Providence, R. I., is circulating a 16-page illustrated booklet in which the advantages of an automatic sprinkling system, as a fire protection is pointed out. The booklet contains a number of illustrations showing buildings which were recently destroyed by fire, etc. Interesting data is also given in a record of fire between Sept. 1 and Dec. 1, 1920.

BELTING—The Consolidated Belting Co., Philadelphia, has published a 24-page illustrated booklet, in which leather belting, straps and leather specialties are described and illustrated. The first part of the booklet is devoted to describing and illustrating various departments of the company's plant. Some interesting tables and data are given in the back part of the booklet.

GAS ENGINES—The C. & G. Cooper Co., Mt. Vernon, O., has published a 40-page illustrated booklet in which it described and illustrates gas engines which it manufactures. These include horizontal double-acting, 4-cycle single and twin tandem types. The illustrations show installations at various plants, and include line drawings. Specifications and other data are given.

ELECTRODES—The Republic Carbon Co., Inc., Niagara Falls, N. Y., has published a 46-page illustrated booklet in which electrodes and their use are described and illustrated. Some of the data given, include information on the operation of electric furnaces, oxidation, etc., and a number of tables are given including electric steel furnaces by countries, atomic weights, method of determining current density, calculation of temperature by the rise in resistance, etc.

FACTORY SKYLIGHTS—A 26-page illustrated booklet has been published by The G. Drouve Co., Bridgeport, Conn., in which a glass roofing, which is held in place without the aid of putty, for industrial structures, is described and illustrated. The illustrations show the interior of various plants, which are equipped with this type of roof, and which show the extent of natural lighting and ventilation.

ELECTRIC HEATERS—The Cutler-Hammer Mfg. Co., Milwaukee, is circulating a 4-page illustrated folder in which an electric heater is described and illustrated. Heaters of this type, according to the folder, are adapted to heating crane cabs, outhouses, valve, pump and meter houses, exposed plant corners, watch and signal towers, for shearmen and tablemen in steel plants, and various other uses including residential heating. Full details are given.

HEATERS—A closed or tubular type of heater is described and illustrated in a 40-page illustrated booklet recently published by the Ross Heater & Mfg. Co., Inc., Buffalo. These heaters are designed for the heating of all fluids through any range of temperature. There are two types of heaters, one known as the instantaneous heater, in which the liquid is heated as it is being used, and the other is the storage heater, which has a storage capacity to be drawn on in emergencies. The heater is described in detail and specifications are given.

INDUSTRIAL BUILDINGS—An interesting 56-page illustrated booklet has been published by the H. K. Ferguson Co., Cleveland, in which standard factory buildings are described and illustrated. The booklet is replete with details as to construction and the illustrations are of plants already in operation. In connection with the illustrations each plant is described in detail. Nine distinct types of buildings are included in the descriptions. The latter part of the booklet contains specifications, details of construction and design, the installation of heating, etc.

ELEVATORS—The Dodge Sales & Engineering Co., Mishawaka, Ind., has published a new catalog in which elevators and conveyors are described and illustrated. The booklet is 6 x 9 inches, contains 160 pages, and is printed on enameled paper. It contains 105 illustrations, tables and complete data covering this equipment. An interesting feature is the simple manner in which designs involving gearing are worked out, whereby almost any drive whether for a conveyor or elevator, can be picked out of tables. The catalog was prepared under the direction of A. O. Gates.

TURBO-GENERATOR SETS—Small turbo-generator sets are described and illustrated in an 8-page booklet recently published by the General Electric Co., Schenectady, N. Y. The turbine operates on the impulse principle where the steam is expanded in the inlet nozzles with a consequent loss of pressure, and the acquirement of considerable velocity. In this condition the steam enters the buckets of the wheel, which, while revolving, reduce the velocity of the steam and absorb its energy which is put to use in generating electricity. The turbine is described in detail.

PORTABLE TOOLS—The Wodack Electric Tool Corp., Chicago, is circulating a 4-page leaflet in which portable electric drills and grinders are described and illustrated. The motors of the electric drills are of the series laminated type and are self-adjustable in speed to the size bits used. The switch is of a quick make and break, located in the top handle and is operated with the palm of the hand, current shutting off automatically as the pressure is released. The grinder is designed for smoothing down castings, buffing and polishing. The motor in this tool is completely inclosed and has self-oiling bearings. Other data and complete specifications are given.

SIGNAL SYSTEM—The Tele-Call Co., Cleveland, has published a large 12-page illustrated booklet, in which a system for calling executives, when they are not within hearing distance of their telephone bell, is described. The booklet contains a number of illustrations, showing the loss of time in searching for a factory superintendent, who was out of his office when a long distance telephone call was received for him, and in addition to the loss of time, the disturbances to men in other offices, caused by inquiring for him. Another illustration, shows how the time loss could be avoided, by the signaling system, which may be operated as an auxiliary to the telephone switchboard.

FOUNDRY REPAIRS—The Metal & Thermit Corp., New York, has issued a revised edition of its thermit welding pamphlet, in which the application of this method of welding as applied to mill and foundry repairs is described and illustrated. New practices are described and illustrations showing recent interesting repairs on certain types of equipment are given. The booklet contains a general discussion of the proper applications and fields for oxyacetylene, electric and thermit welding. It describes methods to be followed and apparatus to be used in welding iron and steel sections in general. It also outlines special applications of thermit welding, such as for crankshaft, pinion and roll repairs and cast iron welding. A description of a new method of welding teeth in pinions is also given, as well as other interesting details and data.

CARBONFREE METALS—The Metal & Thermit Corp., New York, has issued a new edition of its pamphlet No. 20. This pamphlet, in addition to containing a description of the properties and characteristics of the various carbonfree metals and alloys manufactured by the company, includes an extensive explanation, of what the company claims, are the advantages to be obtained by the use of tablets of pure tungsten metal, in the production of high speed steel and other alloys containing tungsten. According to the booklet by using these tablets, mechanical losses which occur during shipping, etc., are reduced because of the uniform size of the tablets, and in addition it is claimed metallurgical losses caused by oxidation in melting and by the absorption of tungsten by the crucible and electric furnace lining, are reduced because by the use of the tablets the melting time is reduced and there is a higher recovery of tungsten owing to the fact that the tablets melt down with the charge.

INDUSTRIAL HAULAGE—The General Electric Co., Schenectady, N. Y., has issued an attractive illustrated bulletin in which it describes some of the representative types of electric locomotives which have been used in a wide variety of industries. The list of industries, in which these locomotives are shown at work, includes foundries, shipyards, steel plants, by-product coke plants, ore docks, chemical plants, brick yards, stone quarries, cement plants, docks, and warehouses, power houses, ash handling and manufacturing plants in general. Many advantages are claimed for electric locomotives in factory transportation, all of which are outlined in the bulletin. The locomotives are of the trolley, third rail, storage battery and combination trolley and storage battery types. In construction they are of single or double truck type and the standard sizes vary in weight from 4 to 50 or more tons.